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14. ABSTRACT

Mild traumatic brain injury (mTBI) is one of the major health problems facing military servicemembers returning from deployments. White matter axonal damage, as measured by neuroimaging techniques like Diffusion Weighted Imaging (DWI), is one of the hypothesized mechanisms contributing to the cognitive and affective sequalae of mTBI. Presently, many of the findings in the literature examining the association between DWI and neuropsychological outcome are contradictory, possibly due to differences in stage of recovery at the time of assessment. This study will address this problem by collecting measures of white matter integrity and concomitant neuropsychological status at five time points in the first year following an mTBI. During the first year, study preparations, including ethical approval, hiring and training of new staff, purchasing of equipment and materials, and validation of neuroimaging protocols, were completed ahead of schedule. During the past year, we have collected usable data from a total of 13 participants. These data have been cleaned and preliminary analyses suggest that we are able to identify meaningful trends in the data, although the sample is still far too small to make valid conclusions.

15. SUBJECT TERMS

TBI, traumatic brain injury, concussion, DWI, white matter, brain imaging, light therapy neuropsychological performance, neurocognitive performance, structural connectivity

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1. INTRODUCTION

Mild traumatic brain injury (mTBI), or concussion, is among the most common injuries reported during recent military conflicts (Hoge et al., 2008). For a significant proportion of individuals who sustain an mTBI, post-concussive symptoms (PCS) may persist for years after the injury and interfere with daily functioning (Satz et al., 1999). Persistent sleep disruption is one of the most common complaints in patients with mTBI (Baumann, Werth, Stocker, Ludwig, & Bassetti, 2007; Castriotta et al., 2007; Makley et al., 2008; Parcell, Ponsford, Redman, & Rajaratnam, 2008; Rao et al., 2008; Verma, Anand, & Verma, 2007; Williams, Lazic, & Ogilvie, 2008), with as many as 40 to 65% complaining of insomnia (Beetar, Guilmette, & Sparadeo, 1996; Dikmen, McLean, & Temkin, 1986; Orff, Ayalon, & Drummond, 2009). Because sleep is critical to the neurogenesis and neural plasticity necessary for recovery from mTBI, sleep enhancement may be an ideal candidate for direct intervention or adjunct treatment of PCS. Because sleep-wake rhythms are highly affected by circadian factors, a novel but potentially effective approach for improving sleep in patients with mTBI is selective application of bright light. Exposure to bright blue-wavelength light (BL) has been shown to stimulate melanopsin receptors in the retina, which are directly linked to the suprachiasmatic nucleus, a part of the hypothalamus that regulates sleep-wake cycles through production of melatonin (Brainard et al., 2008; Phipps-Nelson, Redman, Schlangen, & Rajaratnam, 2009; Revell & Skene, 2007; Smith, Revell, & Eastman, 2008). Targeted morning stimulation with BL suppresses early morning melatonin levels, entrains circadian rhythm, and phase advances the individual, leading to improved sleep quality and daytime alertness (Lack, Gradisar, Van Someren, Wright, & Lushington, 2008; Lack & Wright, 2007; Skene, 2003). There is evidence that BL treatment reduces fatigue in patients who have experienced mTBI (Ponsford et al., 2012), but no study has directly examined the structural and functional brain changes associated with BL treatment and its influence on sleep following mTBI. We recently completed pilot work suggesting that this approach may lead to some changes in brain structure and function that could be helpful in facilitating recovery from concussion. Thus, the present study aims to: 1) extend our earlier pilot work to double the overall sample size to 60 participants across the currently active and proposed studies (30 per condition); 2) evaluate the longevity of treatment effects using actigraphic monitoring for six weeks after treatment; and 3) identify the brain regions most affected by blue relative to amber light exposure by assessing the acute effects of a single 30-minute exposure to blue light versus amber placebo light in 30 healthy control participants. This Effect Localization Arm will inform focal regions of interest (ROIs) for in-depth analysis of treatment-related changes in neural activation and connectivity in the mTBI treatment portion of the study.

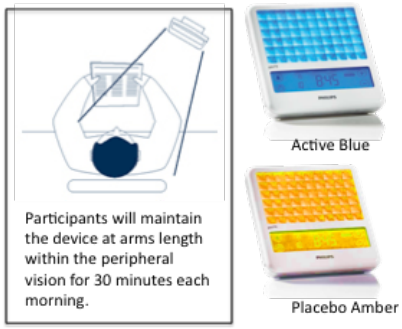


Figure 1. The blue (active) and amber (placebo) light devices.

2. KEY WORDS:

TBI, Traumatic brain injury, concussion, brain imaging, neuropsychological performance, neurocognitive performance, structural connectivity, sleep disruption

3. **ACCOMPLISHMENTS:**

- **What were the major goals and objectives of the project?**

According to the Statement of Work (SOW), the following major tasks were proposed:

EFFECT LOCALIZATION ARM:

Major Task 1: Prepare Regulatory Documents and Research Protocol for both arms of study. **(**Y1: Q1-2**)**
Completed: 25 AUG 2014

Major Task 2: Acquire necessary materials and equipment for effect localization arm.(Y1: Q1-2)
Completed: 01 DEC 2014

Major Task 3: Hire and Train Study Staff. (Y1: Q2)
Completed: 01 DEC 2014

Major Task 4: Collect data for effect localization arm. (Y1: Q3 – Y2: Q3)
Completed: 01 APR 2015

TREATMENT ARM:

Major Task 1: Acquire necessary materials and equipment for treatment arm (Y1: Q1-2)
Completed: 01 DEC 2014

Major Task 2: Collect data for treatment arm
In progress: data collection is ongoing (see accomplishments below)

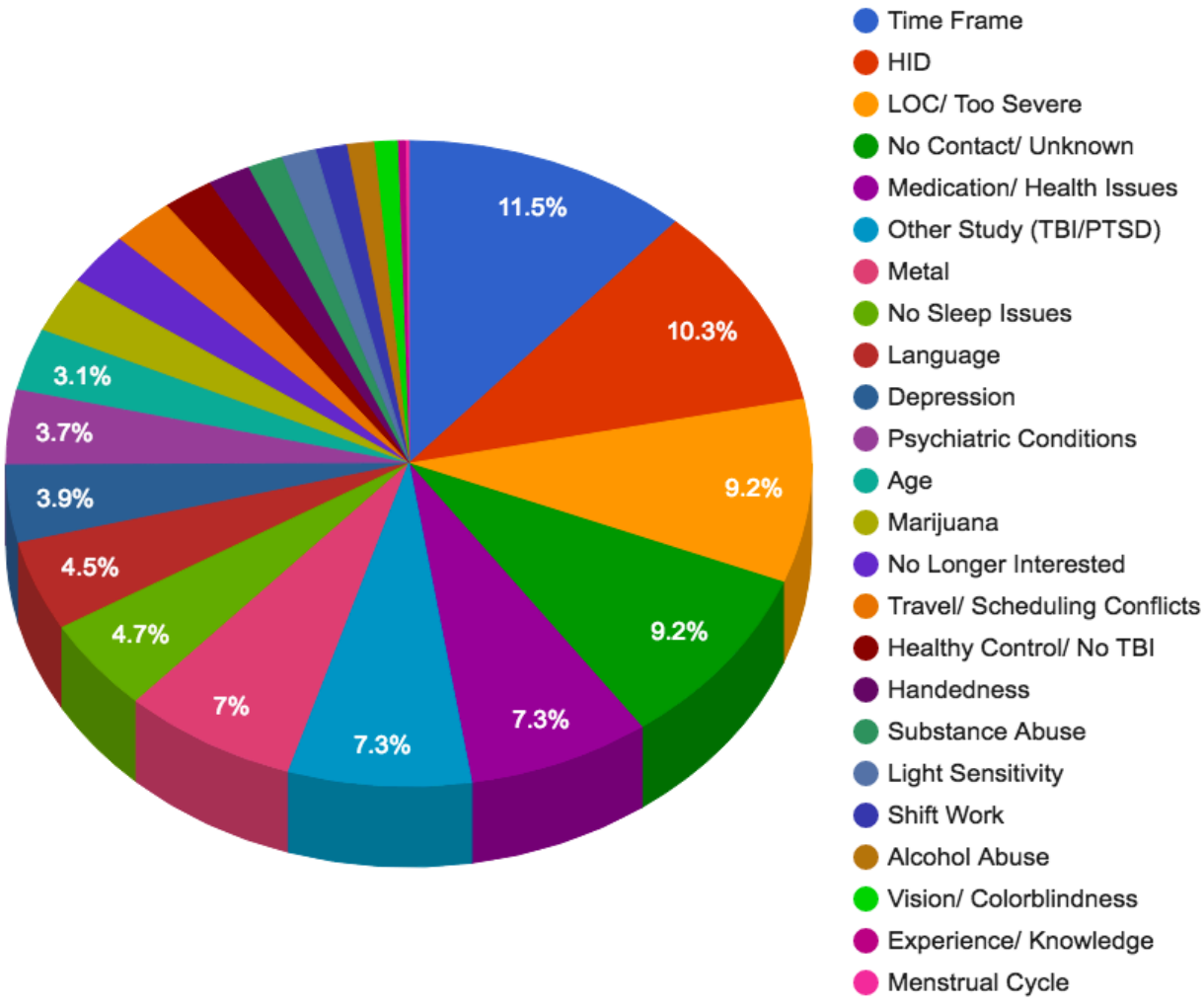
- **What was accomplished under these goals?**
  1) Major Activities: During Year 2 of this project, the majority of the work was focused on participant enrollment and data collection. The major activities have included extensive focus on advertising the study, screening interested volunteers, and, full data collection efforts.

  2) Specific Objectives: The primary objectives for this year were to carry out recruitment and data collection.

  3) Significant Results/Key Outcomes:

Recruitment: We have continued to establish relationships with a large number of local sports teams, businesses, and community service locations throughout Tucson. We have contacted local fitness and athletic centers, collegiate sports head coaches, and medical facilities throughout Tucson and neighboring Oro Valley with requests to place advertisements for this study at their locations. We have established relationships with two major community service locations in the city of Tucson: COPE Community Services and La Frontera Arizona. In addition, we have reached out to adult sports leagues, collegiate intramural sports organizations, and athletic complexes such as the Tucson Women's Soccer League, UA Rugby Team, Maracana Indoor Sports Arena, and Tucson Indoor Sports Center. We have also employed digital means of distributing our recruitment materials to University of Arizona students through numerous departmental listservs.

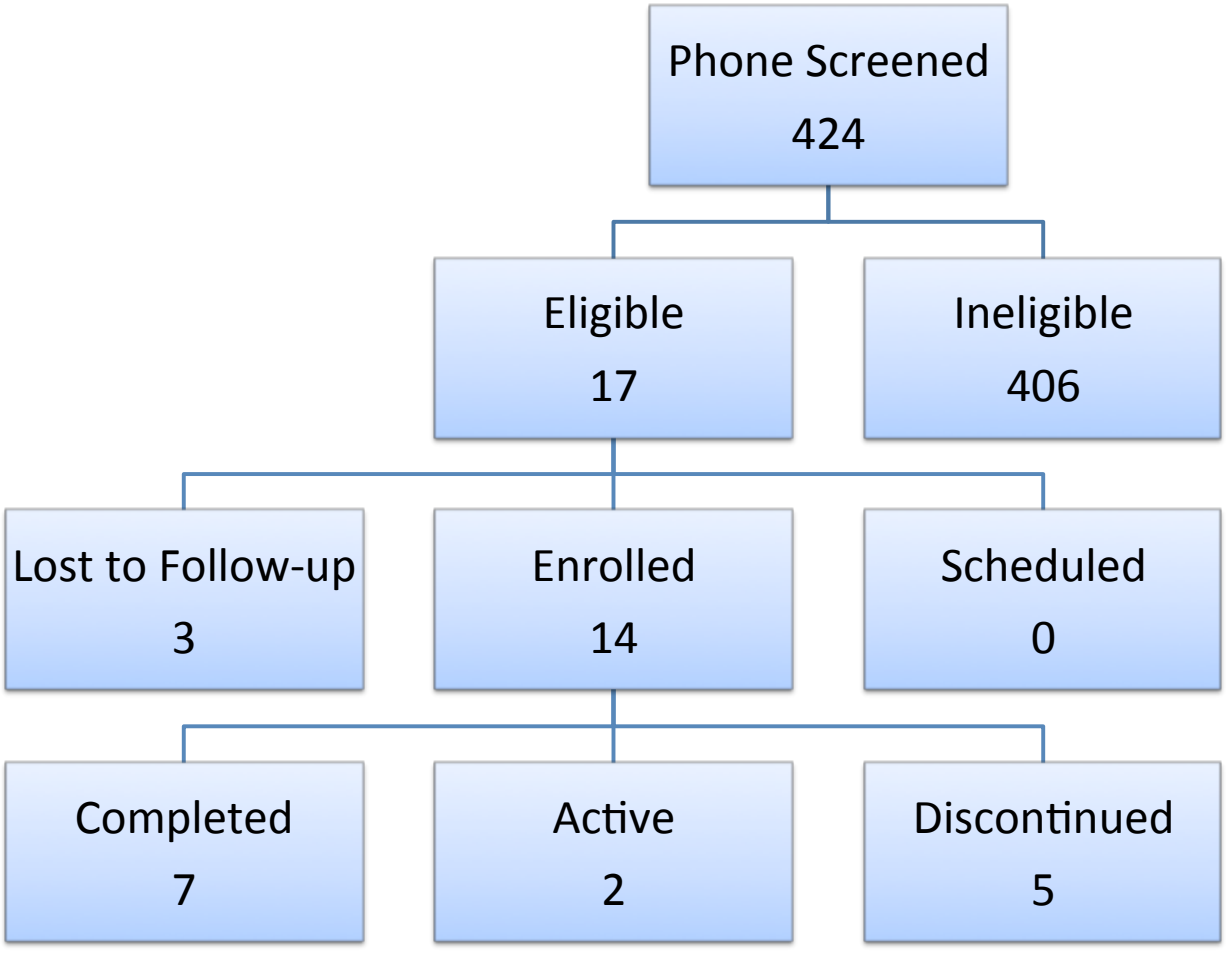
We have continued screening potential participants by phone, and have screened 303 interested individuals (148 male, 155 female) over the past annual reporting period. Of these individuals, 11 were determined to be eligible and 292 were deemed ineligible. Due to the neuroimaging nature of this study, our inclusion criteria are quite stringent. As shown in the figure below, the largest number of potential volunteers were excluded because they did not meet the time frame criteria for having experienced their mTBI within the preceding 18 months before starting the study. The second most common exclusionary criteria was lack of head injury documentation (HID), which required participants to have a signed



document from a medical professional or other person in an official/authority position to vouch for the fact that the participant suffered a head injury and showed altered mental status as a result. The third most common reasons for exclusion included loss of consciousness longer than 30 minutes, failure of the participant to respond to our attempts to contact them for further scheduling, taking exclusionary medicines, simultaneous participation in another study involving the same assessments, or metal in the body (contraindication for MRI scans). Other exclusionary criteria accounted for less than 5% of exclusions and covered a broad range of exclusions.

Of those who were eligible, 3 were enrolled in and completed the study within the past year, 2 were enrolled and are currently active, and 3 were excluded during the course of the study. Of those remaining, 2 eligible individuals have not returned our attempts to contact them, or have otherwise been unable to participate due to a scheduling conflict or other commitment, and 1 is scheduled to come in for the first visit in the next quarter.

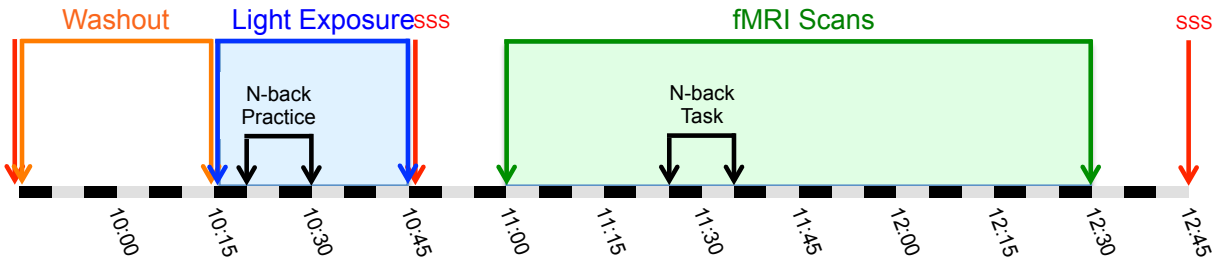
As shown in the Consort diagram below, we have screened a grand total of 424 individuals by phone for the Treatment arm of the study. Of these individuals, a total of 18 have been eligible to participate. Of those, 14 were enrolled in the study and 3 eligible individuals have not returned our attempts to contact them, or have otherwise been unable to participate due to a scheduling conflict or other commitment. Of the 14 enrolled, 7 have completed the study. Two are currently actively undergoing study procedures, and 5 were excluded for various reasons during the study. Briefly, of the 5 who dropped after enrollment, 2 were excluded because they failed to meet basic criteria upon baseline



assessment (1 had no sleep problems, and one was excluded for comorbid pre-existing psychopathology), and 2 were dropped because they failed to show up for their baseline visit, and 1 was dropped due to inability to remain within the time zone for the duration of the study.

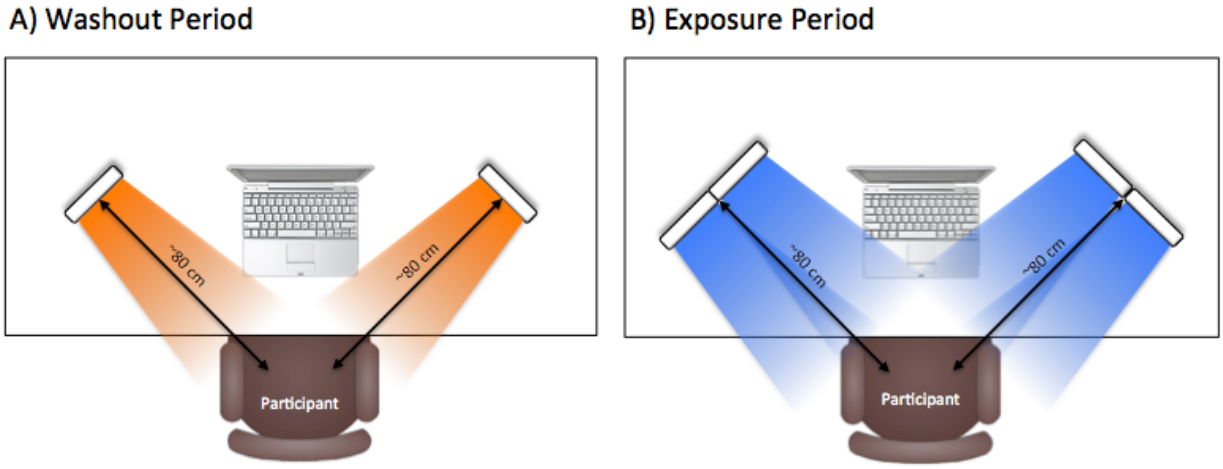
Preprocessing and quality control – ongoing: Consistent with the SOW, all data are being uploaded to secure computer workstations, pre-processed, and checked for errors in acquisition as they are collected. The Lab Manager is overseeing compliance with IRB/HRPO regulations via periodic audit of data storage and test administration by study staff. Behavioral data are being dually entered and verified by Research Technicians, and all collected data are being backed up routinely.

Healthy Control Findings: Data collection for the Effect Localization Arm was completed last year. However, we have continued to carry out analysis of those data and have published some of our findings. Briefly, prolonged exposure to blue wavelength light has been shown to have an alerting effect, and enhances performance on cognitive tasks. A small number of studies have also shown that relatively short exposure to blue light leads to changes in functional brain responses during the period of exposure. The extent to which blue light continues to affect brain functioning during a cognitively challenging task after cessation of longer periods of exposure (i.e., roughly 30 minutes or longer), however, has not been fully investigated. Therefore, for the Effect Localization Arm, we conducted a between-group comparison of blue versus amber placebo control light exposure. For this analysis, a total of 35 healthy participants were exposed to either blue (n = 17) or amber (n = 18) wavelength light for 30 minutes in a darkened room, followed immediately by functional magnetic resonance imaging (fMRI) while undergoing a working memory task (N-back task).



In this part of the study, participants underwent the controlled light exposure while sitting in an otherwise completely darkened room. All participants began with a light *Washout Period* (described in more detail under Procedure) that involved sitting in a dark room while only exposed to two amber light devices (described below) mounted on a desk at a distance of approximately 80 cm from participant nasion, with each light centered at a 45 degree angle from midline (see Figure 1A). Actual distance and angle of the light devices were adjusted manually until the pair of amber devices used during the initial washout period resulted in a 20-lux reading as measured by a light meter (Digital Lux Meter LX1330B) on each side of the participant's nose. During the *Exposure Period,* light was administered by a similar configuration of four light devices, also centered at 45 degrees to each side of the participant with a distance of approximately 80 cm from the participant's nasion (see Figure 1B). During the *Exposure Period*, the light devices were either blue or amber depending on random assignment. Blue light exposure utilized an array of commercially available Philips goLITE BLU® Energy Light devices (Model HF3321/60;

Philips Electronics, Stamford, CT). Each device consisted of a plastic table-mounted chassis with a 10 x 6 array of light emitting diodes (LEDs), encased in 1 x 1 cm cubical projection elements and a translucent plastic window cover. The goLITE BLU is commercially available and has a narrow bandwidth (peaking at λ = 469 nm, at 214 Lux, and panel irradiance (mW/cm^2) = 1.23 at 20 cm). The amber devices were provided by the manufacturer for research purposes and were essentially identical to the goLITE BLU devices, with the exception that they were fitted with amber LEDs (peaking at λ = 578 nm, at 188 Lux, and total irradiance (mW/cm^2) = 0.35).

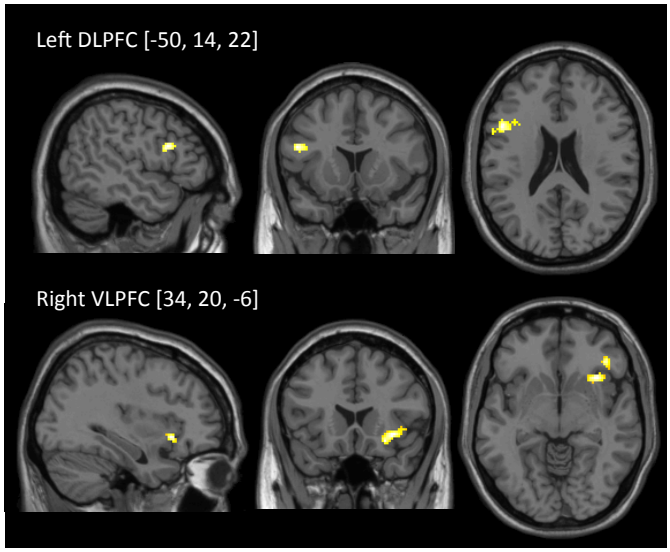


Behavioral Results

A repeated-measures ANOVA showed no differences in self-reported sleepiness, as measured with the SSS, over the three time points ($F(2, 31) = .12$, $p = .88$). There was no difference in accuracy and response time between the blue and amber placebo groups for the zero-back condition, but participants in the blue group responded faster during the one- ($t(33) = -2.26$, $p=.03$) and two-back conditions ($t(33) = -1.98$, $p = .05$) than participants in the amber placebo group.

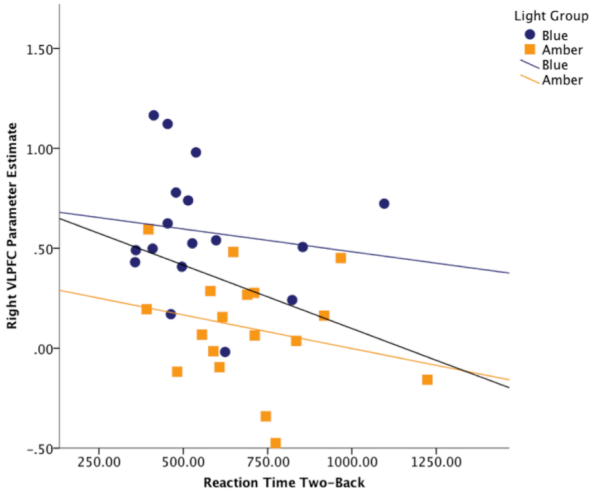
Neuroimaging results

For the two-back > zero-back contrast, individuals in the blue light group showed significantly greater activation in a cluster within the left DLPFC (k = 29; p_{FWE} = .03; t = 4.12; x = -50, y = 14, z = 22, small volume corrected) and a cluster within the right VLPFC (k = 17, p_{FWE} = .006, t = 4.83; x = 34, y = 20, z = -6, small volume corrected) than individuals who were exposed to the amber placebo light (see Figure 3). There were no regions within the brain where amber placebo light exposure was associated with faster response times than blue light exposure.

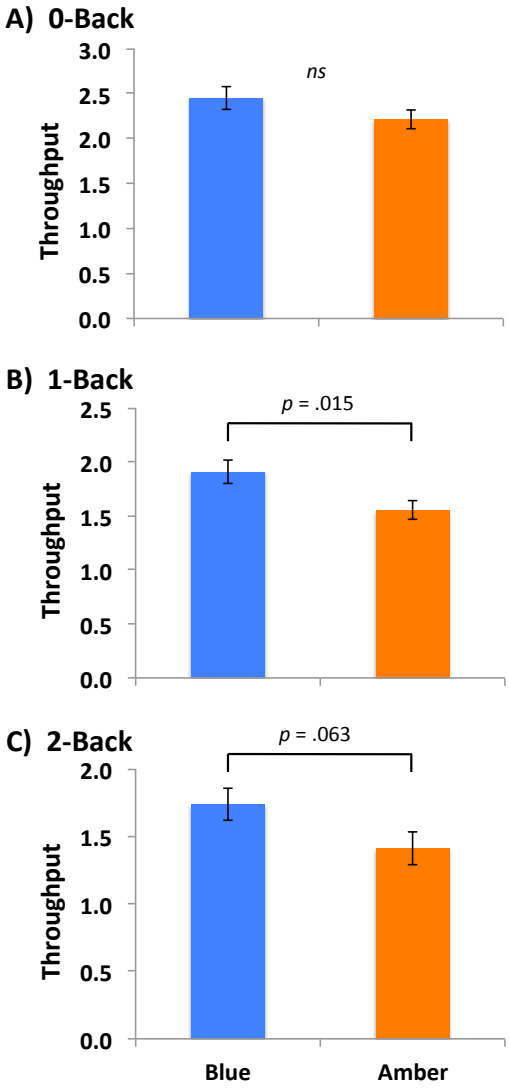


In order to investigate the association between regional activation and behavioral responses, we extracted the activation for the

unadjusted cluster eigenvariate for both brain regions and conducted Pearson's correlations between the eigenvariate and response time and performance metrics during the two-back condition. There was a negative correlation between the VLPFC activation and response time (r = -.35, p = .04). This correlation was present among the sample as a whole and was not driven by one group in particular (see Figure at right). No significant associations with accuracy were found. In addition, no significant associations were found between activation within the DLPFC and performance on the working memory task.

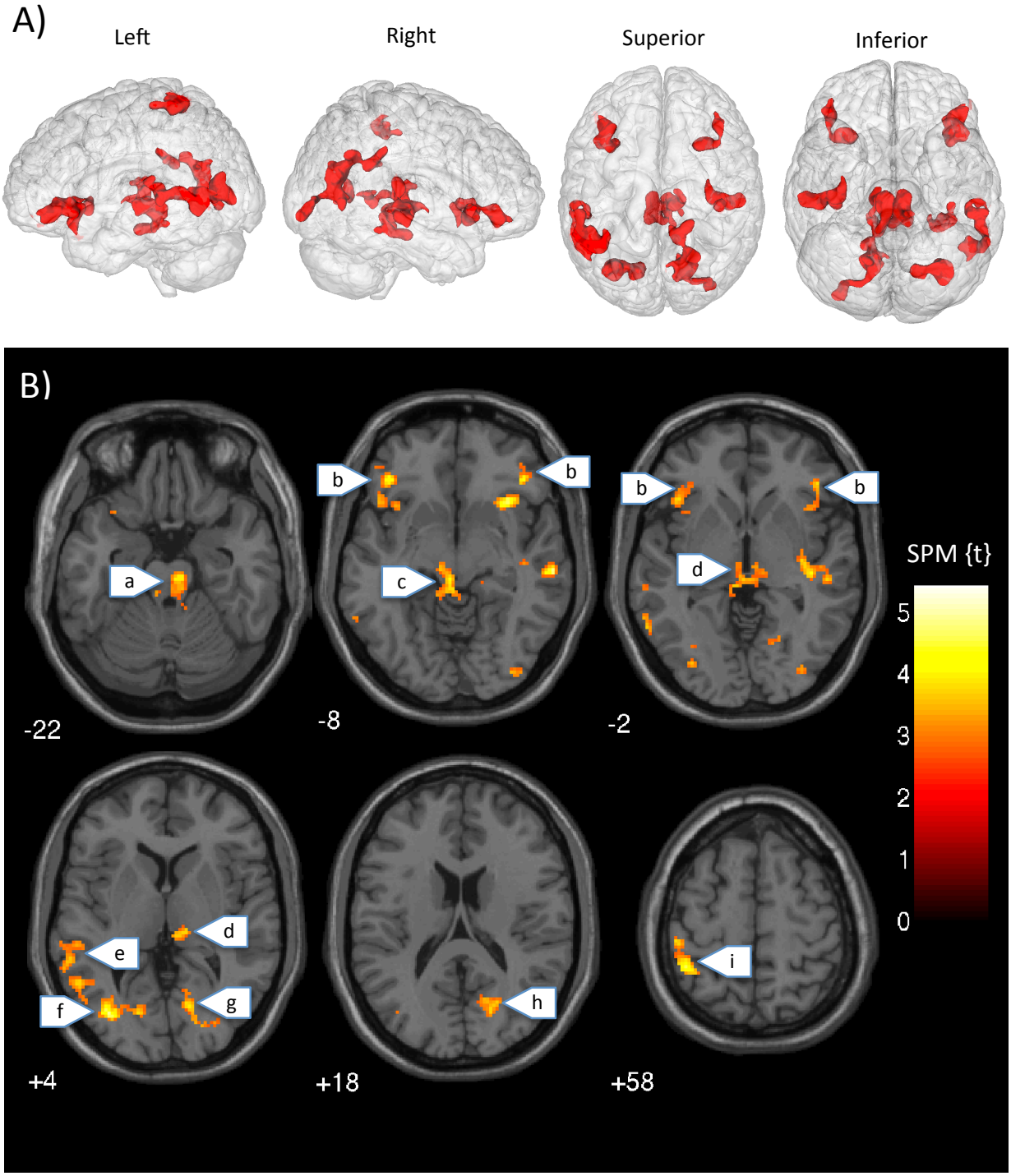


To investigate whether participants were more 'efficient' with increases in working memory (i.e., the number of correct responses per second), a measure of cognitive throughput was calculated ((Accuracy x (1/RT) *1000)) [26]. Throughput provides a quantitative metric of the speed versus accuracy tradeoff. While there was no difference in throughput between the two groups in the zero-back condition (t(33) = -1.60, p = .19), participants in the blue group showed enhanced throughput in the one-back (t(33) = -2.57, p =.01), and marginally higher throughput in the two-back condition (t(33) = -1.92, p =.06) than the amber placebo group. In other words, participants in the blue light group provided a greater number of correct responses per unit of time than participants in the amber placebo group (see Figure 5). Given that the groups were essentially equivalent with regard to accuracy, this difference suggests that exposure to blue light led to faster response times with no loss in accuracy.



Finally, exploratory whole brain analysis was undertaken for the purpose of facilitating future hypothesis generation, with a peak height threshold of p < .005, and cluster-corrected extent threshold of p < .05 (FWE corrected). Again comparing the two-back > zero-back contrast, we found that the blue-wavelength light exposure group showed significantly greater activation than amber placebo light within several distributed regions including left and right VLPFC (i.e., inferior frontal gyrus/insula), left and right middle temporal

gyrus, right posterior cingulate gyrus, left middle occipital cortex, brainstem, and thalamus (see Figure below). There were no regions in the brain showing greater activation to the amber placebo control light compared to blue light during the working memory task.



Overall, this is the first published study to suggest that a relatively brief, single exposure to blue light has a subsequent beneficial effect on working memory performance, even after cessation of exposure, and leads to temporarily persisting functional brain changes within prefrontal brain regions associated with executive functions. These findings may have broader implication for using blue-enriched light in a variety of work settings

where alertness and quick decision-making are important. This paper was recently published in the journal SLEEP (2016), 3, 1671-1680.

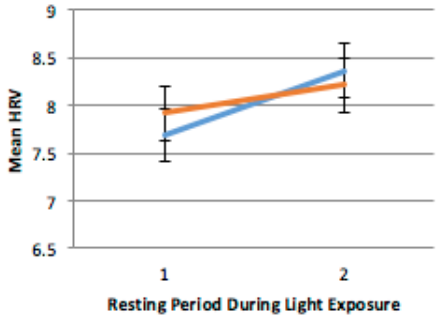
Heart Rate Variability in Healthy Controls: Heart Rate Variability (HRV) has been shown to increase at the onset of sleep. Interestingly, exposure to blue wavelength light prior to sleep can inhibit this increase, suggesting a possible biomarker of increased alertness. In addition, acute exposure to blue light has been demonstrated to increase alertness, reduce sleepiness, and increase performance on the Psychomotor Vigilance Test (PVT), but this has not been directly associated with HRV. We hypothesized that blue light exposure would decrease HRV and increase performance on the PVT. Twenty healthy 18-30 year olds underwent a half hour baseline acclimation period in low amber light at 9:45 a.m., followed by a half hour exposure to bright blue light (469 nm; n=10) or bright amber light (578 nm; n=10). HRV was assessed during a 5 minute resting condition at baseline and during bright light exposure. A change score was calculated between these two resting periods. As a measure of sustained attention, the PVT was administered during the final 10 minutes of the bright light exposure.

There was no significant difference in baseline HRV, performance on the PVT, or sleepiness between the two light conditions. Both groups showed an increase in HRV between baseline and the bright light exposure (p=.001). However, smaller HRV change scores were associated with fewer lapses in vigilance (*p*=.003) and faster reaction time (*p*=.001) on the PVT.

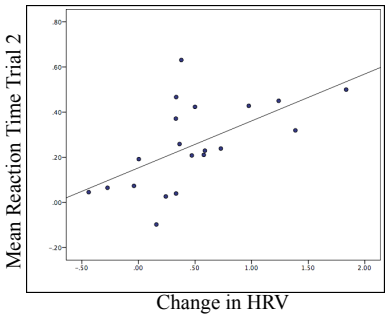
		Reaction Time PVT 1	**Reaction Time PVT 2**	**Lapses PVT 1**	**Lapses PVT 2**
Baseline HRV	Correlation Coefficient	-.391	-.397	-.174	-.302
	Sig. (2-tailed)	.088	.083	.462	.195
	N	20	20	20	20
Post Light Exposure HRV	Correlation Coefficient	-.030	-.002	.163	-.025
	Sig. (2-tailed)	.900	.995	.493	.917
	N	20	20	20	20
Change in HRV	Correlation Coefficient	**.486***	**.602****	**.473***	**.469***
	Sig. (2-tailed)	**.030**	**.005**	**.035**	**.037**
	N	**20**	**20**	**20**	**20**

Contrary to expectations HRV increased for both wavelengths of bright light. However, consistent with our hypotheses, individuals with inhibited HRV increases during light exposure, regardless of wavelength, had better performance on the PVT. Findings suggest that smaller increases in HRV during bright light exposure, regardless of wavelength, may be associated with better sustained attention. Future work may focus on the role of individual differences in HRV during exposure to light on performance during various cognitive tasks.

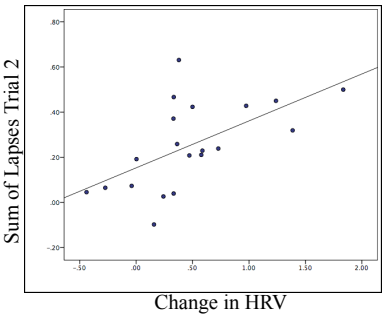
HRV Change



HRV Correlations with PVT Performance

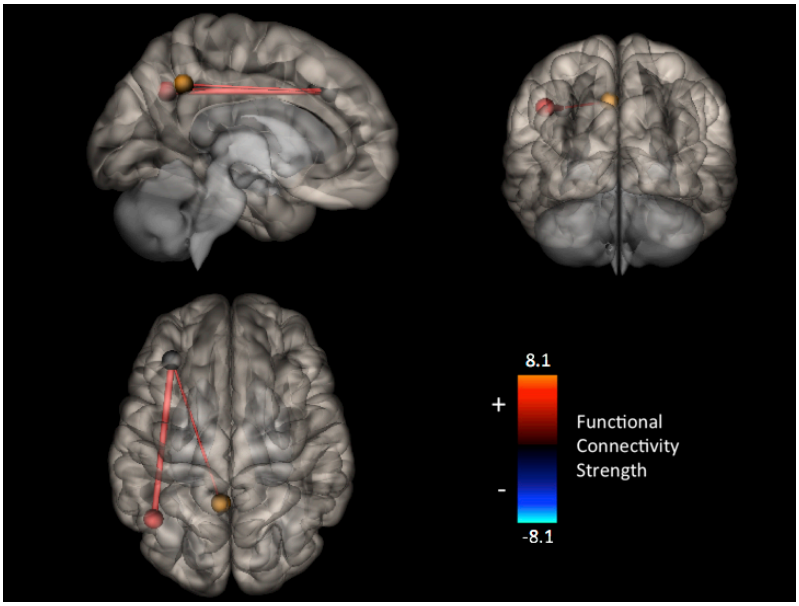


$r_s = .459$



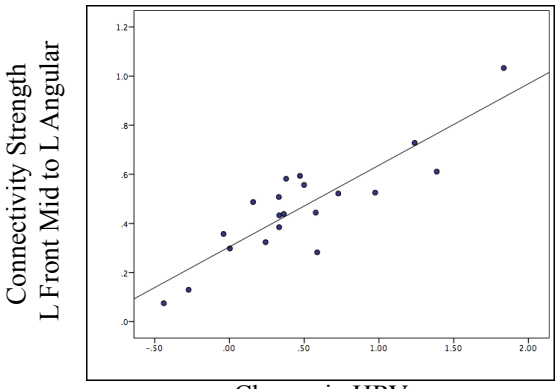
$r_s = .351$

Light Induced Changes in HRV are Associated with Frontoparietal Connectivity: Acute exposure to blue light increases alertness and performance on the Psychomotor Vigilance Task (PVT). Preliminary data from our lab has also shown that smaller changes in heart rate variability (HRV), a measure of cardiac reactivity, can predict PVT performance during bright light exposure. We hypothesized that individuals who show smaller increases in HRV during light exposure (presumably reflecting greater alertness and associated sympathetic tone) would have greater post-exposure frontoparietal connectivity. Twenty healthy 18-30 year olds underwent a half-hour acclimation period at 9:45 a.m. in low amber light (baseline), followed by a half-hour exposure to bright light (blue or amber) at 10:15 a.m. Participants then underwent a six-minute resting state functional magnetic resonance imaging (fMRI) scan at 3T within 10 minutes of cessation of light exposure. Regions of interest were placed in frontal and parietal areas of the cortex as defined by the Automated Anatomical Labeling Atlas. Functional connectivity was analyzed utilizing the CONN toolbox and SPM12, with $p<.05$, FDR corrected. Smaller change in HRV from baseline in response to the bright light exposure, and better PVT performance, correlated positively with increased functional connectivity between the Left Angular Gyrus, and Left Middle Frontal Gyrus; in contrast, it was associated with greater negative functional connectivity between the Left Middle Frontal Gyrus and Right Superior Frontal Orbital Gyrus. During light exposure, attenuated change in HRV was associated with increased functional connectivity within the left fronto-parietal attention network, and better vigilance performance. Findings suggest a link between sympathetic vagal tone as measured by HRV and brain function that is directly associated with



faster response times. The HRV response to light exposure might potentially serve as a trait marker of vulnerability to cognitive decline during sleepiness or fatigue.

Connectivity Correlations with Change in HRV



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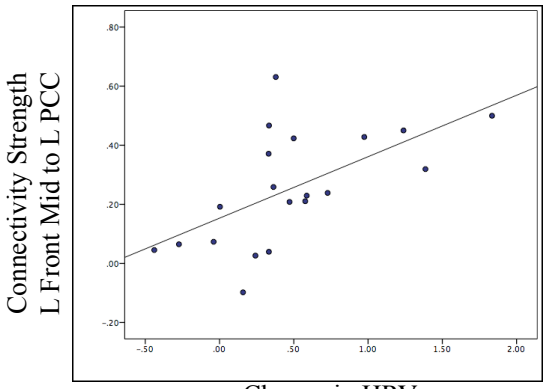

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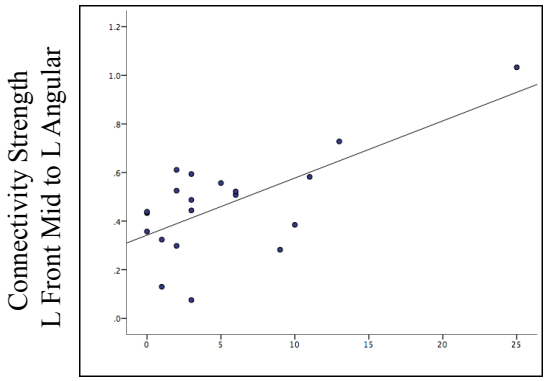
Connectivity Correlations with PVT Performance



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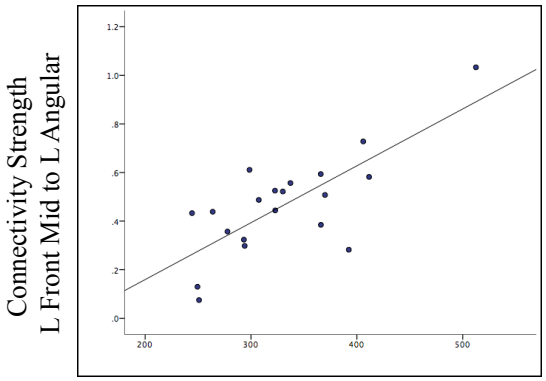


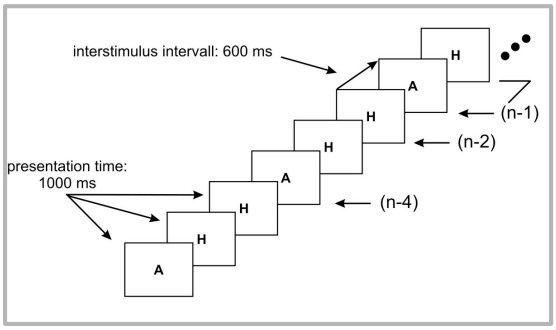
r_s= .565

Mild TBI Preliminary fMRI Findings: At this point in the project, the sample size for the TBI portion of the study is far too small to conduct meaningful analyses with reliable outcomes. However, we present here some preliminary findings with the available data in order to demonstrate the feasibility of the types of analyses we plan to conduct upon completion of data collection. These outcomes are not intended to reflect expected outcomes, but are merely presented to demonstrate our capabilities for conducting the intended analyses. Below, we present preliminary findings from two separate functional magnetic resonance imaging tasks, including the n-back task and the multi-source interference task (MSIT).

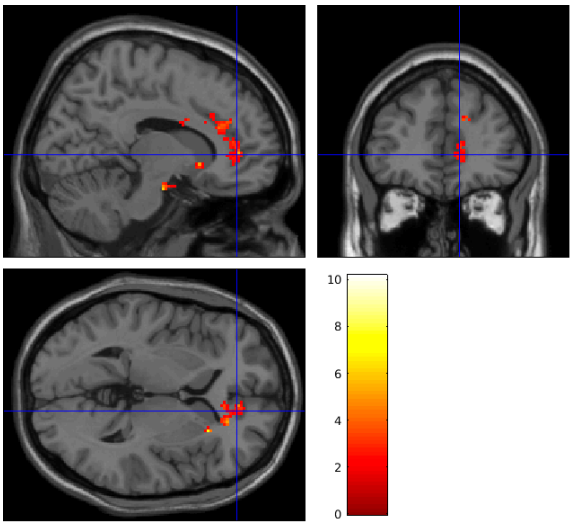
N-back Task: The n-back task is a widely used test of working memory capacity. Essentially, the participant sees a series of letters or digits appear sequentially on the screen one at a time. Depending on the condition (0-back, 1-back, or 2-back), the participant must compare the current letter or digit to one that was shown in the preceding slide (1-back), or two slides previously (2-back), or simply respond each time they see a

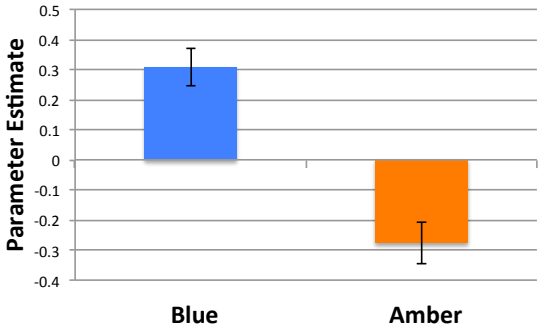
particular letter (0-back). The 2-back condition creates the greatest demand on working memory capacity, as the individual must maintain the information in working memory while attending to other information. Here we conducted a 2 (light condition) x 2 session (pre-treatment vs. post-treatment) analysis of variance (ANOVA). As shown in the figure below, there was a significant interaction ($p < .05$, FDR cluster corrected) between condition and session. Specifically, individuals within the blue light condition showed a significant increase in activation within the rostral anterior cingulate gyrus (rACC) and the nucleus accumbens for the 2-back > 0-back conditions relative to those receiving the amber light placebo condition. These regions are particularly important for anticipatory functions, error monitoring, regulation of emotion, and anticipation of reward. While the samples are far too small to presently draw any meaningful conclusions, these findings are consistent with other work suggesting that blue light treatment can improve mood {Ekstrom, 2014 #4475} and fatigue {Ponsford, 2012 #3639} and is important in anticipatory functions {Alkozei, 2016 #4208}.

n-Back

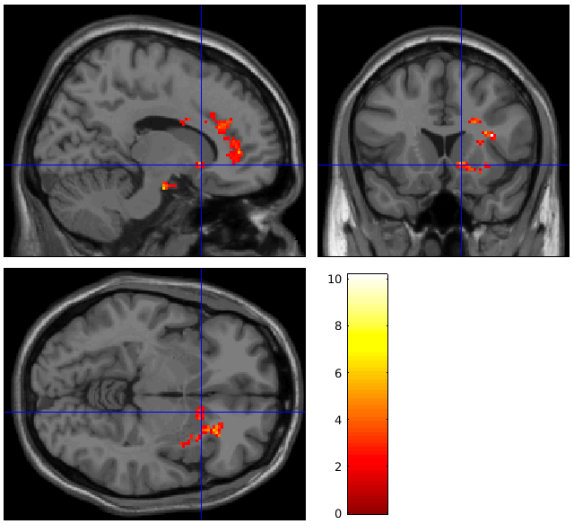


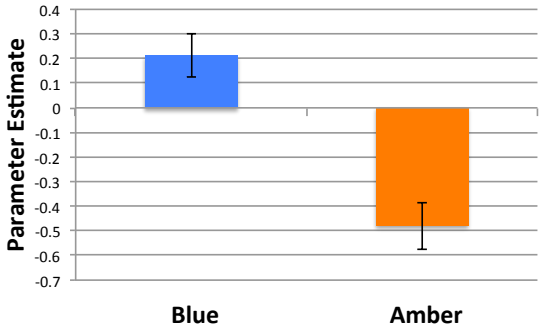
Rostral ACC



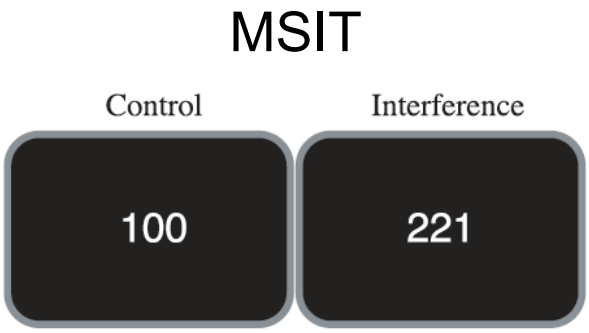


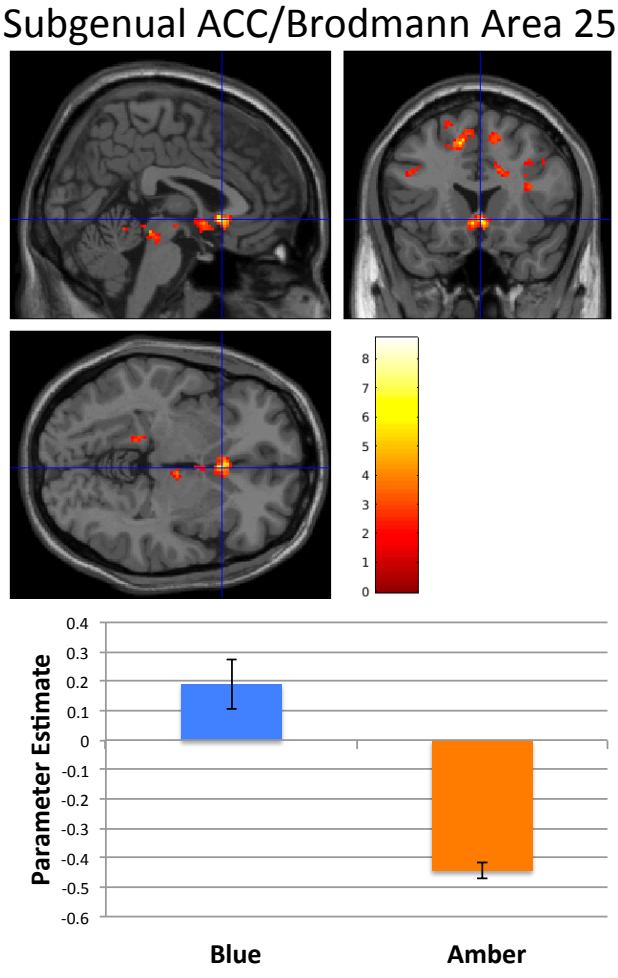
Nucleus Accumbens





MSIT Task: The multi-source interference task (MSIT) is a complex cognitive control task that presents the participant with two conditions. In each condition, the participant sees 3 numbers presented on the computer screen and the participant must press a button to indicate the number that differs from the other two, using a 3-button device. During the control condition, the number that differs is always consistent with the location (i.e., button "1" is always in the first position; button "2" is always in the second position, and so forth). The interference condition is nearly identical, except that the number that differs is always in a different location than the value of the digit that differs (e.g., in the example above, the "1" is the numeral that differs from the others, but it is in the 3rd position, so the correct response is "3"). The interference condition requires inhibition of a prepotent response and is generally much more difficult than the control condition. Here, we conducted a 2 (light condition) x 2 session (pre-treatment vs. post-treatment) analysis of variance (ANOVA). As shown in the figure below, there was a significant interaction ($p < .05$, FDR cluster corrected) between condition and session. The blue light treatment group showed significantly greater activation from pre- to post-treatment within the subgenual cingulate cortex (Brodmann Area 25) relative to those receiving the amber light treatment. The figure shows these activation maps overlaid on a standard template brain. This is consistent some of our own prior work suggesting that this same region is important for alertness/daytime sleepiness {Killgore, 2012 #3717}. Several other cortical regions were also more activated for the blue compared to the amber placebo condition, but these regions were not specifically hypothesized. Again, these data are extremely preliminary and not considered reliable due to the small sample sizes. Rather, they are only presented as representative of the analysis capabilities that will be employed once we achieve a sufficiently powered sample. Once we have completed data collection, we





will evaluate the comparability of the data with our initial pilot sample to determine if it is possible to combine datasets for greater statistical power.

- **What opportunities for training and professional development has the project provided?**

  The project has supported numerous opportunities for members to gain professional proficiency, enrich their training skills expertise, and broaden their understanding of the current research and analyses methods. The project has supported:

  4 members of our lab attended lectures and presented research findings at the International Neuropsychological Society Meeting, Boston, MA, February 3-6, 2016

  3 members of our lab attended lectures and presented research findings at the Society of Biological Psychiatry Meeting, Atlanta, GA, May 12-14, 2016

  4 members of our lab attended lectures and presented research findings at the Associated Professional Sleep Societies Meeting, Denver, CO, June 11-15, 2016

  1 member of our lab attended lectures and presented research findings at the Military Health Systems Research Symposium, Orlando, FL, August 15-18, 2016.

  1 member of our lab attended lectures and presented research findings at the meeting of the Society for Psychophysiological Research, Minneapolis, MN, September 21-25, 2016.

  1 member of our lab attended a workshop entitled: Sleep Health Scoring for the Polysomnographer, Scottsdale, AZ, October 13-14, 2016.

  1 member of our lab attended a workshop entitled: Actigraphy and Fitness/Sleep trackers in Adults and Children: Fundamentals and applications, at the Associated Professional Sleep Societies Meeting, Denver, CO, June 11-15, 2016

  1 postdoc attended the Mind Research Network Functional MRI Training Workshop (Jan 2016) in Albuquerque, NM.

  1 postdoc and 1 graduate student attended the CONN Functional Connectivity Workshop (April 2016), in Boston, MA.

  2 postdocs attended the NIH Grant Writing Workshop at the University of Arizona (August 2016), Tucson, AZ.

  1 postdoc attended the Applied Workshop on the New SCID-5, Mastering the Diagnostic Interview, University of Michigan.

Multiple members of our lab have attended regular training in MRI analysis methods and safety as part of an ongoing training series offered at the University of Arizona.

Multiple members of our lab receive regular one-on-one instruction and supervision in the administration and scoring of neuropsychological assessments, psychodiagnostic testing, electrode placement, and patient interviewing.

Over 15 members of our lab have undergone regular in-house training in the use of various brain-imaging software, including SPM12, Matlab, FSL, Freesurfer, TracVis, MRIcron and others.

Over 15 members of our lab have undergone basic training modules in ethical conduct, statistical analysis, and neuroanatomy.

- **How were the results disseminated to communities of interest?**
  We are continually working to disseminate knowledge of the impact of mild traumatic brain injury and sleep health to academic and clinical communities of interest. Several organizations have been contacted to gain permission to advocate the research and studies conducted by the lab. Several short talks and presentations have been extended to local athletic organizations and departments, medical staff at the Banner University Medical Center - Tucson Hospital, the Southern Arizona VA Health Care System clinic, and the Tucson Vet Center. Preliminary data has also been presented at several research conferences encompassing topics such as neuropsychology, biological psychiatry, and sleep health and medicine.

- **What do you plan to do during the next reporting period to accomplish the goals and objectives?**
  To increase recruitment, we are currently submitting an IRB amendment to gain access to Banner-University Medical Center - Tucson's Electronic Privacy Information Center (EPIC) through a data dump to reach out to individuals who have experienced a concussion within the last 18 months. This would minimize the hindrance of obtaining head injury documentation as well as ensuring the sample population is within the 18-month time frame for this study. In addition, we will continue to actively pursue as many different recruitment outlets throughout the Tucson and Southern Arizona region as possible. We will also initiate the creation of a second sleep database encompassing subject actigraphy analysis by the end of the second quarter of year 3 to complement the sleep log database.

4. **IMPACT**
   - **Effect on the development of the principal discipline(s) of the project**
     Nothing to report
   - **Effect on other disciplines**
     Nothing to report

- **Effect on technology transfer**
  Nothing to report
- **Effect on society beyond science and technology**
  Nothing to report

5. **CHANGES/PROBLEMS**

By far the most challenging aspect of this project is recruitment and retention of participants. We have found that the most frequent exclusionary factor at phone screening is time since injury in excess of 18 months. To address this issue, we are currently in the process of gaining access to the Banner University Medical Center - Tucson's Electronic Privacy Information Center (EPIC), in order to identify individuals who were recently admitted to the emergency room at Banner University Medical Center - Tucson and diagnosed with a concussion or mild traumatic brain injury (mTBI). Access to the EPIC database will allow us to establish direct contact with individuals who have experienced a concussion or mTBI within the past 18 months. As this method of recruitment will make use of medical records, utilizing the EPIC database will also fulfill the need for head injury documentation, the lack of which is our second greatest barrier to enrollment.

6. **PRODUCTS**

Peer Reviewed Publications:

Alkozei, A, Smith, R, Pisner, D, Vanuk, JR, Markowski, SM, Fridman, A, Shane, BR, Knight, SA, & **Killgore, WD**. Exposure to blue light increases later functional activation of the prefrontal cortex during working memory. SLEEP, 3, 1671-1680, 2016.

Alkozei, A, Smith, R, & **Killgore, WD**. Exposure to blue wavelength light modulates anterior cingulate cortex activation in response to 'uncertain' versus 'certain' anticipation of positive stimuli. Neuroscience Letters, 616, 5-10, 2016.

Killgore, WD. Lighting the way to better sleep and health (Editorial). Journal of Sleep Disorders: Treatment and Care, 5:1.

Published Abstracts:

Alkozei, A & **Killgore, WD**. Exposure to blue wavelength light is associated with increased dorsolateral prefrontal cortex responses during a working memory task. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

Alkozei, A & **Killgore, WD.** Exposure to blue wavelength light suppresses anterior cingulate cortex activation in response to uncertainty during anticipation of negative or

positive stimuli. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

Alkozei, A, Markowski, SM, Pisner, D, Fridman, A, Shane, BR, Vanuk, JR, Knight, SA, & **Killgore, WD.** Exposure to blue wavelength light reduces activation within the anterior cingulate cortex during anticipation of certain reward stimuli. Abstract presented at the 71st Annual Scientific Convention of the Society for Biological Psychiatry, Atlanta, GA, May 12-14, 2016.

Alkozei, A., Pisner, D, Markowski, SM, Vanuk, JR, Fridman, A, Shane, BR, Knight SA, & **Killgore, WD.** Increases in prefrontal activation after exposure to blue versus amber wavelength light during cognitive load. Abstract presented at the 71st Annual Scientific Convention of the Society for Biological Psychiatry, Atlanta, GA, May 12-14, 2016.

Alkozei, A, Pisner, D, Markowski, SM, Vanuk, JR, Fridman, A, Shane, BR, Knight, SA, Grandner, MA, & **Killgore, WD.** Exposure to blue wavelength light is associated with increased dorsolateral prefrontal cortex responses and increases in response times during a working memory task. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

Vanuk, JR, Alkozei, A, Smith, R, Pisner, D, Markowski, SM, Shane, BR, Fridman, A, Knight, SA, Grandner, MA, & **Killgore, WD.** Changes in heart rate variability due to light exposure predict frontoparietal connectivity. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

Vanuk, JR, Alkozei, A, Knight, SA, Fridman, A, Markowski, SM, Pisner, D, Shane, BR, Grandner, MA, & **Killgore, WD.** The effects of light exposure on heart rate variability predict sleepiness and vigilance. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

Vanuk, JR, Allen, JJB, & **Killgore, WD**. Heart rate variability during light exposure and subsequent network connectivity patterns. Abstract presented at the Annual Meeing of the Society for Psychophysiological Research, Minneapolis, MN, September 21-25, 2016.

The Actigraphy data for all completed Treatment Arm participants has been initially scored and is currently in the process of being double-scored. Inter-rater reliability was scored to evaluate consistency of the Research Technicians' scoring and data entry (97.4%). We aim

to have an actigraphy database created within the next reporting period. An SPSS sleep database has been created to store all sleep logs submitted electronically by the participants.

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

- **What individuals have worked on the project?**

Name: William D. “Scott” Killgore, Ph.D.
Project Role: PI
Nearest person month worked: 4
Contribution to Project: Dr. Killgore oversees all aspects of project progress and orchestrates data analysis and publication efforts.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571
USAMRAA W81XWH-11-1-0056
USAMRAA W81XWH-16-1-0062
USAMRAA W81XWH-12-1-0386

Name: Anna Alkozei, Ph.D.
Project Role: Postdoctoral Fellow
Nearest person month worked: 4
Contribution to Project: Dr. Alkozei performs data analysis and processing for the project.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571
USAMRAA W81XWH-11-1-0056
USAMRAA W81XWH-12-1-0386

Name: Ryan Smith, Ph.D.
Project Role: Postdoctoral Fellow
Nearest person month worked: 4
Contribution to Project: Dr. Smith performs data analysis and processing for the project.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571
USAMRAA W81XWH-11-1-0056
USAMRAA W81XWH-12-1-0386

Name: Sara Knight
Project Role: Lab Manager
Nearest person month worked: 3
Contribution to Project: Ms. Knight oversees the administrative needs of the study and study staff, in addition to providing regulatory support and performing periodic quality control checks.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571

USAMRAA W81XWH-11-1-0056
USAMRAA W81XWH-16-1-0062
USAMRAA W81XWH-12-1-0386

Name: Matthew Allbright
Project Role: Research Technician
Nearest person month worked: 3
Contribution to Project: Mr. Allbright oversees the technical aspects of the project and assists in database export, storage, and management.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571
USAMRAA W81XWH-11-1-0056
USAMRAA W81XWH-12-1-0386

Name: Sarah (Markowski) Berryhill
Project Role: Research Technician
Nearest person month worked: 4
Contribution to Project: Mrs. Berryhill provides support with data collection and recruitment activities.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571
USAMRAA W81XWH-16-1-0062
USAMRAA W81XWH-12-1-0386

Name: Alyssa Dormer
Project Role: Research Technician
Nearest person month worked: 1
Contribution to Project: Ms. Dormer provides support with data collection and recruitment activities.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571
USAMRAA W81XWH-11-1-0056
USAMRAA W81XWH-16-1-0062
USAMRAA W81XWH-12-1-0386

Name: Andrew Fridman
Project Role: Research Technician
Nearest person month worked: 4
Contribution to Project: Mr. Fridman provides support with data collection and recruitment activities.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571
USAMRAA W81XWH-12-1-0386

Name: Miyla McIntosh
Project Role: Research Technician
Nearest person month worked: 3
Contribution to Project: Ms. McIntosh provided support with data collection and recruitment activities.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571
USAMRAA W81XWH-12-1-0386

Name: Melissa Millan
Project Role: Research Technician
Nearest person month worked: 4
Contribution to Project: Ms. Millan oversees project progress and manages the day-to-day needs of the project.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571
USAMRAA W81XWH-12-1-0386

Name: William Palmer
Project Role: Research Technician
Nearest person month worked: 3
Contribution to Project: Mr. Palmer provided support with data collection and recruitment activities.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571
USAMRAA W81XWH-12-1-0386

Name: Derek Pisner
Project Role: Research Technician
Nearest person month worked: 3
Contribution to Project: Mr. Pisner previously oversaw project progress and managed the day-to-day needs of the project.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571
USAMRAA W81XWH-12-1-0386

Name: Prabhjyot Singh
Project Role: Research Technician
Nearest person month worked: 3
Contribution to Project: Mr. Singh previously assisted with data collection and recruitment activities.
Funding support: USAMRAA W81XWH-14-1-0570
USAMRAA W81XWH-14-1-0571
USAMRAA W81XWH-12-1-0386

- **Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?**

  Since the last reporting period, the PI has added effort on two other projects. The first project is funded by USAMRAA W81XWH-16-1-0062 and expires in APR 2020. This grant was previously pending and is now active. The second project is funded by USAMRAA W81XWH-11-1-0056 and expires 31 OCT 2016. This award was pending transfer from the PI's former institution until earlier this year.

- **What other organizations were involved as partners?**

  Nothing to report.

8. SPECIAL REPORTING REQUIREMENTS

Nothing to report

9. APPENDICES: **Page**

Bright Light Therapy for Treatment of Sleep Problems Following Mild TBI Study
Tasks and Assessments

Screening Visit

VA National Traumatic Brain Injury Neurobehavioral Symptom Inventory (NSI)
Screen Time Questionnaire (STQ)
Mini-International Neuropsychiatric Interview (MINI)
Edinburgh Handedness Survey (EHS)
Personality Assessment Inventory (PAI)
Wechsler Abbreviated Scale of Intelligence II (WASI II)

Baseline and Post-Treatment Visits

Stanford Sleepiness Scale (SSS)
Multi-Source Interference Task (MSIT)
N-Back Task
Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)
ANAM4 Battery
Psychomotor Vigilance Test (PVT)
Invincibility Beliefs Index (IBI)
Go/No-Go Task (GNG)
Day of Scan Questionnaire
Morningness-Eveningness Questionnaire (MEQ)
Functional Outcome of Sleep Questionnaire (FOSQ)
Evaluation of Risks Scale (EVAR)
Patient Health Questionnaire (PHQ)
Pittsburgh Sleep Quality Index (PSQI)
Rivermead Post-Concussion Symptoms Questionnaire (RPCSQ)
Beck Depression Inventory (BDI-II)
Balloon Analog Risk Task (BART)
Spielberger State-Trait Anxiety Inventory (STAI)
Tower of London (TOL)
Satisfaction with Life Scale (SWLS)

Appendix II: Symptom Checklist Included in VA's National Traumatic Brain Injury Evaluation and Treatment Protocol

NEUROBEHAVIORAL SYMPTOM INVENTORY

Please rate the following symptoms with regard to how much they have disturbed you *SINCE YOUR INJURY*.

0 = None- Rarely if ever present; not a problem at all

1 = Mild- Occasionally present, but it does not disrupt activities; I can usually continue what I'm doing; doesn't really concern me.

2 = Moderate- Often present, occasionally disrupts my activities; I can usually continue what I'm doing with some effort; I feel somewhat concerned.

3 = Severe- Frequently present and disrupts activities; I can only do things that are fairly simple or take little effort; I feel like I need help.

4 = Very Severe- Almost always present and I have been unable to perform at work, school or home due to this problem; I probably cannot function without help.

1. Feeling dizzy:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

2. Loss of balance:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

3. Poor coordination, clumsy:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

4. Headaches:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

5. Nausea:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

6. Vision problems, blurring, trouble seeing:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

7. Sensitivity to light

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

8. Hearing difficulty:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

9. Sensitivity to noise:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

10. Numbness or tingling on parts of my body:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

11. Change in taste and/or smell:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

12. Loss of appetite or increase appetite:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

13. Poor concentration, can't pay attention, easily distracted:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

14. Forgetfulness, can't remember things:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

15. Difficulty making decisions:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

16. Slowed thinking, difficulty getting organized, can't finish things:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

17. Fatigue, loss of energy, getting tired easily:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

18. Difficulty falling or staying asleep:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

19. Feeling anxious or tense:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

20. Feeling depressed or sad:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

21. Irritability, easily annoyed:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

22. Poor frustration tolerance, feeling easily overwhelmed by things:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

Subject Number: _____ Date:_____

In a typical week, we would like to know how much and when you are using your TV and Computer. Please place a C (computer) and/or T (television) in each hour time slot to indicate use.

Time	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
12AM							
1AM							
2AM							
3AM							
4AM							
5AM							
6AM							
7AM							
8AM							
9AM							
10AM							
11AM							
12PM							
1PM							
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3PM							
4PM							
5PM							
6PM							
7PM							
8PM							
9PM							
10PM							
11PM							

M.I.N.I.

MINI INTERNATIONAL NEUROPSYCHIATRIC INTERVIEW

English Version 6.0.0

DSM-IV

USA: **D. Sheehan[1], J. Janavs, K. Harnett-Sheehan, M. Sheehan, C. Gray.**
[1]University of South Florida College of Medicine- Tampa, USA

EU: **Y. Lecrubier[2], E. Weiller, T. Hergueta, C. Allgulander, N. Kadri, D. Baldwin, C. Even.**
[2]Centre Hospitalier Sainte-Anne – Paris, France

DISCLAIMER

Our aim is to assist in the assessment and tracking of patients with greater efficiency and accuracy. Before action is taken on any data collected and processed by this program, it should be reviewed and interpreted by a licensed clinician.

This program is not designed or intended to be used in the place of a full medical and psychiatric evaluation by a qualified licensed physician – psychiatrist. It is intended only as a tool to facilitate accurate data collection and processing of symptoms elicited by trained personnel.

M.I.N.I. 6.0.0 (January 1, 2009)

		Patient Number:	
		Time Interview Began:	
Interviewer's Name:		***Time Interview Ended:***	
Date of Interview:		***Total Time:***	

	MODULES	TIME FRAME	MEETS CRITERIA	DSM-IV-TR	ICD-10	PRIMARY DIAGNOSIS
A	MAJOR DEPRESSIVE EPISODE	Current (2 weeks)	☐	296.20-296.26 Single	F32.x	☐
		Past	☐	296.20-296.26 Single	F32.x	☐
		Recurrent	☐	296.30-296.36 Recurrent	F33.x	☐
B	SUICIDALITY	Current (Past Month) ☐ Low ☐ Moderate ☐ High	☐			
C	MANIC EPISODE	Current	☐	296.00-296.06	F30.x-F31.9	☐
		Past	☐			
	HYPOMANIC EPISODE	Current	☐	296.80-296.89	F31.8-F31.9/F34.0	☐
		Past	☐			
	BIPOLAR I DISORDER	Current	☐	296.0x-296.6x	F30.x-F31.9	☐
		Past	☐	296.0x-296.6x	F30.x-F31.9	☐
	BIPOLAR II DISORDER	Current	☐	296.89	F31.8	☐
		Past	☐	296.89	F31.8	☐
	BIPOLAR DISORDER NOS	Current	☐	296.80	F31.9	☐
		Past	☐	296.80	F31.9	☐
D	PANIC DISORDER	Current (Past Month)	☐	300.01/300.21	F40.01-F41.0	☐
		Lifetime	☐			
E	AGORAPHOBIA	Current	☐	300.22	F40.00	☐
F	SOCIAL PHOBIA (Social Anxiety Disorder)	Current (Past Month)				
		Generalized	☐	300.23	F40.1	☐
		Non-Generalized	☐	300.23	F40.1	☐
G	OBSESSIVE-COMPULSIVE DISORDER	Current (Past Month)	☐	300.3	F42.8	☐
H	POSTTRAUMATIC STRESS DISORDER	Current (Past Month)	☐	309.81	F43.1	☐
I	ALCOHOL DEPENDENCE	Past 12 Months	☐	303.9	F10.2x	☐
	ALCOHOL ABUSE	Past 12 Months	☐	305.00	F10.1	☐
J	SUBSTANCE DEPENDENCE (Non-alcohol)	Past 12 Months	☐	304.00-.90/305.20-.90	F11.1-F19.1	☐
	SUBSTANCE ABUSE (Non-alcohol)	Past 12 Months	☐	304.00-.90/305.20-.90	F11.1-F19.1	☐
K	PSYCHOTIC DISORDERS	Lifetime	☐	295.10-295.90/297.1/	F20.xx-F29	☐
		Current	☐	297.3/293.81/293.82/ 293.89/298.8/298.9		
	MOOD DISORDER WITH	Lifetime	☐	296.24/296.34/296.44	F32.3/F33.3/	☐
	PSYCHOTIC FEATURES	Current	☐	296.24/296.34/296.44	F30.2/F31.2/F31.5 F31.8/F31.9/F39	☐
L	ANOREXIA NERVOSA	Current (Past 3 Months)	☐	307.1	F50.0	☐
M	BULIMIA NERVOSA	Current (Past 3 Months)	☐	307.51	F50.2	☐
	ANOREXIA NERVOSA, BINGE EATING/PURGING TYPE	Current	☐	307.1	F50.0	☐
N	GENERALIZED ANXIETY DISORDER	Current (Past 6 Months)	☐	300.02	F41.1	☐
O	MEDICAL, ORGANIC, DRUG CAUSE RULED OUT		☐ No	☐ Yes ☐Uncertain		
P	ANTISOCIAL PERSONALITY DISORDER	Lifetime	☐	301.7	F60.2	☐

IDENTIFY THE PRIMARY DIAGNOSIS BY CHECKING THE APPROPRIATE CHECK BOX.
(Which problem troubles you the most or dominates the others or came first in the natural history?)

The translation from DSM-IV-TR to ICD-10 coding is not always exact. For more information on this topic see Schulte-Markwort. Crosswalks ICD-10/DSM-IV-TR. Hogrefe & Huber Publishers 2006.

GENERAL INSTRUCTIONS

The M.I.N.I. was designed as a brief structured interview for the major Axis I psychiatric disorders in DSM-IV and ICD-10. Validation and reliability studies have been done comparing the M.I.N.I. to the SCID-P for DSM-III-R and the CIDI (a structured interview developed by the World Health Organization). The results of these studies show that the M.I.N.I. has similar reliability and validity properties, but can be administered in a much shorter period of time (mean 18.7 ± 11.6 minutes, median 15 minutes) than the above referenced instruments. It can be used by clinicians, after a brief training session. Lay interviewers require more extensive training.

INTERVIEW:

In order to keep the interview as brief as possible, inform the patient that you will conduct a clinical interview that is more structured than usual, with very precise questions about psychological problems which require a yes or no answer.

GENERAL FORMAT:

The M.I.N.I. is divided into **modules** identified by letters, each corresponding to a diagnostic category.

•At the beginning of each diagnostic module (except for psychotic disorders module), screening question(s) corresponding to the main criteria of the disorder are presented in a **gray box**.

•At the end of each module, diagnostic box(es) permit the clinician to indicate whether diagnostic criteria are met.

CONVENTIONS:

Sentences written in « normal font » should be read exactly as written to the patient in order to standardize the assessment of diagnostic criteria.

Sentences written in « CAPITALS » should not be read to the patient. They are instructions for the interviewer to assist in the scoring of the diagnostic algorithms.

Sentences written in « **bold** » indicate the time frame being investigated. The interviewer should read them as often as necessary. Only symptoms occurring during the time frame indicated should be considered in scoring the responses.

Answers with an arrow above them (➡) indicate that one of the criteria necessary for the diagnosis(es) is not met. In this case, the interviewer should go to the end of the module, circle « **NO** » in all the diagnostic boxes and move to the next module.

When terms are separated by a *slash (/)* the interviewer should read only those symptoms known to be present in the patient (for example, question G6).

Phrases in (parentheses) are clinical examples of the symptom. These may be read to the patient to clarify the question.

RATING INSTRUCTIONS:

All questions must be rated. The rating is done at the right of each question by circling either Yes or No. Clinical judgment by the rater should be used in coding the responses. Interviewers need to be sensitive to the diversity of cultural beliefs in their administration of questions and rating of responses. The rater should ask for examples when necessary, to ensure accurate coding. The patient should be encouraged to ask for clarification on any question that is not absolutely clear.

The clinician should be sure that each dimension of the question is taken into account by the patient (for example, time frame, frequency, severity, and/or alternatives).

Symptoms better accounted for by an organic cause or by the use of alcohol or drugs should not be coded positive in the M.I.N.I. The M.I.N.I. Plus has questions that investigate these issues.

For any questions, suggestions, need for a training session or information about updates of the M.I.N.I., please contact:

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A. MAJOR DEPRESSIVE EPISODE

(➡ MEANS : GO TO THE DIAGNOSTIC BOXES, CIRCLE **NO** IN ALL DIAGNOSTIC BOXES, AND MOVE TO THE NEXT MODULE)

A1	a	Were you <u>ever</u> depressed or down, most of the day, nearly every day, for two weeks?	NO	YES
		IF NO, CODE NO TO **A1b**: IF **YES** ASK:		
	b	<u>For the past two weeks,</u> were you depressed or down, most of the day, nearly every day?	NO	YES
A2	a	Were you <u>ever</u> much less interested in most things or much less able to enjoy the things you used to enjoy most of the time, for two weeks?	NO	YES
		IF NO, CODE NO TO **A2b**: IF **YES** ASK:		
	b	In the <u>past two weeks</u>, were you much less interested in most things or much less able to enjoy the things you used to enjoy, most of the time?	NO	YES
		➡ IS **A1a** OR **A2a** CODED **YES**?	NO	YES

A3 IF **A1b** OR **A2b** = **YES**: EXPLORE THE **CURRENT** AND THE MOST SYMPTOMATIC **PAST** EPISODE, OTHERWISE
IF **A1b** AND **A2b** = **NO**: EXPLORE ONLY THE MOST SYMPTOMATIC **PAST** EPISODE

Over that two week period, when you felt depressed or uninterested:

		<u>Past 2 Weeks</u>		<u>Past Episode</u>	
a	Was your appetite decreased or increased nearly every day? Did your weight decrease or increase without trying intentionally (i.e., by ±5% of body weight or ±8 lbs. or ±3.5 kgs., for a 160 lb./70 kg. person in a month)? IF **YES** TO EITHER, CODE **YES**.	NO	YES	NO	YES
b	Did you have trouble sleeping nearly every night (difficulty falling asleep, waking up in the middle of the night, early morning wakening or sleeping excessively)?	NO	YES	NO	YES
c	Did you talk or move more slowly than normal or were you fidgety, restless or having trouble sitting still almost every day?	NO	YES	NO	YES
d	Did you feel tired or without energy almost every day?	NO	YES	NO	YES
e	Did you feel worthless or guilty almost every day?	NO	YES	NO	YES
	IF **YES**, ASK FOR EXAMPLES. THE EXAMPLES ARE CONSISTENT WITH A DELUSIONAL IDEA. Current Episode ❒ No ❒ Yes; Past Episode ❒ No ❒ Yes				
f	Did you have difficulty concentrating or making decisions almost every day?	NO	YES	NO	YES
g	Did you repeatedly consider hurting yourself, feel suicidal, or wish that you were dead? Did you attempt suicide or plan a suicide? IF **YES TO EITHER, CODE YES.**	NO	YES	NO	YES
A4	Did these symptoms cause significant problems at home, at work, socially, at school or in some other important way?	NO	YES	NO	YES

A5 In between 2 episodes of depression, did you ever have an interval of at least 2 months, without any significant depression or any significant loss of interest? NO YES

ARE **5** OR MORE ANSWERS (**A1-A3**) CODED **YES** AND IS **A4** CODED YES FOR THAT TIME FRAME?

SPECIFY IF THE EPISODE IS CURRENT AND / OR PAST.

IF **A5** IS CODED **YES,** CODE **YES** FOR RECURRENT.

NO	**YES**
MAJOR DEPRESSIVE EPISODE	
CURRENT	❒
PAST	❒
RECURRENT	❒

A6 a How many episodes of depression did you have in your lifetime? _____

Between each episode there must be at least 2 months without any significant depression.

B. SUICIDALITY

				Points
	In the past month did you:			
B1	Suffer any accident? IF NO TO B1, SKIP TO B2; IF YES, ASK B1a:	NO	YES	0
B1a	Plan or intend to hurt yourself in that accident either actively or passively (e.g. not avoiding a risk)? IF NO TO B1a, SKIP TO B2: IF YES, ASK B1b:	NO	YES	0
B1b	Intend to die as a result of this accident?	NO	YES	0
B2	Feel hopeless?	NO	YES	1
B3	Think that you would be better off dead or wish you were dead?	NO	YES	1
B4	Want to harm yourself or to hurt or to injure yourself or have mental images of harming yourself?	NO	YES	2
B5	Think about suicide? IF NO TO B5, SKIP TO B7. OTHERWISE ASK:	NO	YES	6

Frequency		Intensity	
Occasionally	❒	Mild	❒
Often	❒	Moderate	❒
Very often	❒	Severe	❒

	Can you state that you will not act on these impulses during this treatment program?	NO	YES	
B6	Feel unable to control these impulses?	NO	YES	8
B7	Have a suicide plan?	NO	YES	8
B8	Take any active steps to prepare to injure yourself or to prepare for a suicide attempt in which you expected or intended to die?	NO	YES	9
B9	Deliberately injure yourself without intending to kill yourself?	NO	YES	4
B10	Attempt suicide? IF NO SKIP TO B11: Hope to be rescued / survive ❒ Expected / intended to die ❒	NO	YES	9
	In your lifetime:			
B11	Did you ever make a suicide attempt?	NO	YES	4

IS AT LEAST **1** OF THE ABOVE (EXCEPT B1) CODED **YES**?

IF YES, ADD THE TOTAL POINTS FOR THE ANSWERS (B1-B11) CHECKED 'YES' AND SPECIFY THE SUICIDALITY SCORE AS INDICATED IN THE DIAGNOSTIC BOX:

MAKE ANY ADDITIONAL COMMENTS ABOUT YOUR ASSESSMENT OF THIS PATIENT'S CURRENT AND NEAR FUTURE SUICIDALITY IN THE SPACE BELOW:

NO **YES**

SUICIDALITY CURRENT

1-8 points	Low	❒
9-16 points	Moderate	❒
≥ 17 points	High	❒

C. MANIC AND HYPOMANIC EPISODES

(➡ MEANS : GO TO THE DIAGNOSTIC BOXES, CIRCLE NO IN MANIC AND HYPOMANIC DIAGNOSTIC BOXES, AND MOVE TO NEXT MODULE)

Do you have any family history of manic depressive illness or bipolar disorder, or any family member who had mood swings treated with a medication like lithium, sodium valproate (Depakote) or lamotrigine (Lamictal)? NO YES

THIS QUESTION IS NOT A CRITERION FOR BIPOLAR DISORDER, BUT IS ASKED TO INCREASE THE CLINICIAN'S VIGILANCE ABOUT THE RISK FOR BIPOLAR DISORDER .

IF YES, PLEASE SPECIFY WHO:_____

C1 a Have you **ever** had a period of time when you were feeling 'up' or 'high' or 'hyper' or so full of energy or full of yourself that you got into trouble, - or that other people thought you were not your usual self? (Do not consider times when you were intoxicated on drugs or alcohol.) NO YES

IF PATIENT IS PUZZLED OR UNCLEAR ABOUT WHAT YOU MEAN BY 'UP' OR 'HIGH' OR 'HYPER', CLARIFY AS FOLLOWS: By 'up' or 'high' or 'hyper' I mean: having elated mood; increased energy; needing less sleep; having rapid thoughts; being full of ideas; having an increase in productivity, motivation, creativity, or impulsive behavior; phoning or working excessively or spending more money.

IF NO, CODE NO TO **C1b**: IF **YES** ASK:

b Are you currently feeling 'up' or 'high' or 'hyper' or full of energy? NO YES

C2 a Have you **ever** been persistently irritable, for several days, so that you had arguments or verbal or physical fights, or shouted at people outside your family? Have you or others noticed that you have been more irritable or over reacted, compared to other people, even in situations that you felt were justified? NO YES

IF NO, CODE NO TO **C2b**: IF **YES** ASK:

b Are you currently feeling persistently irritable? NO YES

➡

IS **C1a** OR **C2a** CODED **YES**? NO YES

C3 IF **C1b** OR **C2b** = **YES**: EXPLORE THE **CURRENT** AND THE MOST SYMPTOMATIC **PAST** EPISODE, OTHERWISE
IF **C1b** AND **C2b** = **NO**: EXPLORE ONLY THE MOST SYMPTOMATIC **PAST** EPISODE

During the times when you felt high, full of energy, or irritable did you:

		Current Episode		Past Episode	
a	Feel that you could do things others couldn't do, or that you were an especially important person? IF **YES**, ASK FOR EXAMPLES. THE EXAMPLES ARE CONSISTENT WITH A DELUSIONAL IDEA. Current Episode ❒ No ❒ Yes Past Episode ❒ No ❒ Yes	NO	YES	NO	YES
b	Need less sleep (for example, feel rested after only a few hours sleep)?	NO	YES	NO	YES
c	Talk too much without stopping, or so fast that people had difficulty understanding?	NO	YES	NO	YES
d	Have racing thoughts?	NO	YES	NO	YES

		Current Episode		Past Episode	
e	Become easily distracted so that any little interruption could distract you?	NO	YES	NO	YES
f	Have a significant increase in your activity or drive, at work, at school, socially or sexually or did you become physically or mentally restless?	NO	YES	NO	YES
g	Want so much to engage in pleasurable activities that you ignored the risks or consequences (for example, spending sprees, reckless driving, or sexual indiscretions)?	NO	YES	NO	YES

C3 SUMMARY: WHEN RATING CURRENT EPISODE: NO YES NO YES

IF C1b IS NO, ARE 4 OR MORE C3 ANSWERS CODED YES?
IF C1b IS YES, ARE 3 OR MORE C3 ANSWERS CODED YES?

WHEN RATING PAST EPISODE:
IF C1a IS NO, ARE 4 OR MORE C3 ANSWERS CODED YES?
IF C1a IS YES, ARE 3 OR MORE C3 ANSWERS CODED YES?

CODE YES ONLY IF THE ABOVE 3 OR 4 SYMPTOMS OCCURRED DURING THE SAME TIME PERIOD.

RULE: ELATION/EXPANSIVENESS REQUIRES ONLY THREE C3 SYMPTOMS, WHILE IRRITABLE MOOD ALONE REQUIRES 4 OF THE C3 SYMPTOMS.

		Current Episode	Past Episode
C4	What is the longest time these symptoms lasted?		
	a) 3 days or less	❒	❒
	b) 4 to 6 days	❒	❒
	c) 7 days or more	❒	❒

C5	Were you hospitalized for these problems?	NO	YES	NO	YES

IF YES, STOP HERE AND CIRCLE YES IN MANIC EPISODE FOR THAT TIME FRAME.

C6	Did these symptoms cause significant problems at home, at work, socially in your relationships with others, at school or in some other important way?	NO	YES	NO	YES

ARE **C3** SUMMARY AND **C5** AND **C6** CODED **YES** AND EITHER **C4a or b or c** CODED **YES**?

OR

ARE **C3** SUMMARY AND **C4c** AND **C6** CODED **YES** AND IS **C5** CODED **NO**?

SPECIFY IF THE EPISODE IS CURRENT AND / OR PAST.

NO **YES**

MANIC EPISODE

CURRENT ❒
PAST ❒

ARE **C3** SUMMARY **AND C5** AND **C6** CODED **NO** AND EITHER **C4b** OR **C4c** CODED **YES**?

OR

ARE **C3** SUMMARY AND **C4b** AND **C6** CODED **YES** AND IS **C5** CODED **NO?**

SPECIFY IF THE EPISODE IS CURRENT AND / OR PAST.

NO **YES**

HYPOMANIC EPISODE

CURRENT ❒
PAST ❒

ARE **C3** SUMMARY AND **C4a** CODED **YES** AND IS **C5** CODED **NO**? **NO** **YES**

HYPOMANIC SYMPTOMS

SPECIFY IF THE EPISODE IS CURRENT AND / OR PAST.

CURRENT ❒
PAST ❒

C7 a) IF MANIC EPISODE IS POSITIVE FOR EITHER CURRENT OR PAST ASK:
Did you have 2 or more manic episodes (**C4c**) in your lifetime (including the current episode if present)? NO YES

b) IF HYPOMANIC EPISODE IS POSITIVE FOR EITHER CURRENT OR PAST ASK:
Did you have 2 or more hypomanic EPISODES (**C4b**) in your lifetime (including the current episode)? NO YES

c) IF PAST "HYPOMANIC SYMPTOMS" IS CODED POSITIVE ASK:
Did you have 2 or more episodes of hypomanic SYMPTOMS (**C4a**) in your lifetime
(including the current episode if present)? NO YES

D. PANIC DISORDER

(➡ MEANS : CIRCLE NO IN D5, D6 AND D7 AND SKIP TO E1)

D1	a	Have you, on more than one occasion, had spells or attacks when you **suddenly** felt anxious, frightened, uncomfortable or uneasy, even in situations where most people would not feel that way?	➡ NO	YES
	b	Did the spells surge to a peak within 10 minutes of starting?	➡ NO	YES
D2		At any time in the past, did any of those spells or attacks come on unexpectedly or occur in an unpredictable or unprovoked manner?	➡ NO	YES
D3		Have you ever had one such attack followed by a month or more of persistent concern about having another attack, or worries about the consequences of the attack - or did you make a significant change in your behavior because of the attacks (e.g., shopping only with a companion, not wanting to leave your house, visiting the emergency room repeatedly, or seeing your doctor more frequently because of the symptoms)?	NO	YES
D4		**During the worst attack that you can remember:**		
	a	Did you have skipping, racing or pounding of your heart?	NO	YES
	b	Did you have sweating or clammy hands?	NO	YES
	c	Were you trembling or shaking?	NO	YES
	d	Did you have shortness of breath or difficulty breathing?	NO	YES
	e	Did you have a choking sensation or a lump in your throat?	NO	YES
	f	Did you have chest pain, pressure or discomfort?	NO	YES
	g	Did you have nausea, stomach problems or sudden diarrhea?	NO	YES
	h	Did you feel dizzy, unsteady, lightheaded or faint?	NO	YES
	i	Did things around you feel strange, unreal, detached or unfamiliar, or did you feel outside of or detached from part or all of your body?	NO	YES
	j	Did you fear that you were losing control or going crazy?	NO	YES
	k	Did you fear that you were dying?	NO	YES
	l	Did you have tingling or numbness in parts of your body?	NO	YES
	m	Did you have hot flushes or chills?	NO	YES
D5		ARE BOTH **D3,** AND **4** OR MORE **D4** ANSWERS, CODED **YES**? IF YES TO D5, SKIP TO D7.	NO	YES *PANIC DISORDER LIFETIME*
D6		IF **D5** = **NO,** ARE ANY D4 ANSWERS CODED **YES**? THEN SKIP TO **E1.**	NO	YES *LIMITED SYMPTOM ATTACKS LIFETIME*

D7 In the past month, did you have such attacks repeatedly (2 or more), and did you have persistent concern about having another attack, or worry about the consequences of the attacks, or did you change your behavior in any way because of the attacks? NO YES

PANIC DISORDER CURRENT

E. AGORAPHOBIA

E1 Do you feel anxious or uneasy in places or situations where help might not be available or escape might be difficult, like being in a crowd, standing in a line (queue), when you are alone away from home or alone at home, or when crossing a bridge, or traveling in a bus, train or car or where you might have a panic attack or the panic-like symptoms we just spoke about? NO YES

IF **E1** = **NO**, CIRCLE **NO** IN **E2**.

E2 Do you fear these situations so much that you avoid them, or suffer through them, or need a companion to face them? NO YES

AGORAPHOBIA CURRENT

IS **E2** (CURRENT AGORAPHOBIA) CODED **YES**

and

IS **D7** (CURRENT PANIC DISORDER) CODED **YES**?

NO **YES**

PANIC DISORDER with Agoraphobia CURRENT

IS **E2** (CURRENT AGORAPHOBIA) CODED **NO**

and

IS **D7** (CURRENT PANIC DISORDER) CODED **YES**?

NO **YES**

PANIC DISORDER without Agoraphobia CURRENT

IS **E2** (CURRENT AGORAPHOBIA) CODED **YES**

and

IS **D5** (PANIC DISORDER LIFETIME) CODED **NO**?

NO **YES**

AGORAPHOBIA, CURRENT without history of Panic Disorder

F. SOCIAL PHOBIA (Social Anxiety Disorder)

(➡ MEANS : GO TO THE DIAGNOSTIC BOX, CIRCLE NO AND MOVE TO THE NEXT MODULE)

F1	In the past month, did you have persistent fear and significant anxiety at being watched, being the focus of attention, or of being humiliated or embarrassed? This includes things like speaking in public, eating in public or with others, writing while someone watches, or being in social situations.	➡ NO	YES
F2	Is this social fear excessive or unreasonable and does it almost always make you anxious?	➡ NO	YES
F3	Do you fear these social situations so much that you avoid them or suffer through them most of the time?	➡ NO	YES
F4	Do these social fears disrupt your normal work, school or social functioning or cause you significant distress?		

SUBTYPES

Do you fear and avoid 4 or more social situations?

If YES Generalized social phobia (social anxiety disorder)

If NO Non-generalized social phobia (social anxiety disorder)

EXAMPLES OF SUCH SOCIAL SITUATIONS TYPICALLY INCLUDE

- INITIATING OR MAINTAINING A CONVERSATION,
- PARTICIPATING IN SMALL GROUPS,
- DATING,
- SPEAKING TO AUTHORITY FIGURES,
- ATTENDING PARTIES,
- PUBLIC SPEAKING,
- EATING IN FRONT OF OTHERS,
- URINATING IN A PUBLIC WASHROOM, ETC.

NOTE TO INTERVIEWER: PLEASE ASSESS WHETHER THE SUBJECT'S FEARS ARE RESTRICTED TO NON-GENERALIZED ("ONLY 1 OR SEVERAL") SOCIAL SITUATIONS OR EXTEND TO GENERALIZED ("MOST") SOCIAL SITUATIONS. "MOST" SOCIAL SITUATIONS IS USUALLY OPERATIONALIZED TO MEAN 4 OR MORE SOCIAL SITUATIONS, ALTHOUGH THE DSM-IV DOES NOT EXPLICITLY STATE THIS.

NO **YES**

SOCIAL PHOBIA
(Social Anxiety Disorder)
CURRENT

GENERALIZED ❒

NON-GENERALIZED ❒

G. OBSESSIVE-COMPULSIVE DISORDER

(➡ MEANS: GO TO THE DIAGNOSTIC BOX, CIRCLE NO AND MOVE TO THE NEXT MODULE)

G1 In the past month, have you been bothered by recurrent thoughts, impulses, or images that were unwanted, distasteful, inappropriate, intrusive, or distressing? - (For example, the idea that you were dirty, contaminated or had germs, **or** fear of contaminating others, **or** fear you would act on some impulse, **or** fear or superstitions that you would be responsible for things going wrong, **or** obsessions with sexual thoughts, images or impulses, **or** hoarding, collecting, **or** religious obsessions.)

(DO NOT INCLUDE SIMPLY EXCESSIVE WORRIES ABOUT REAL LIFE PROBLEMS. DO NOT INCLUDE OBSESSIONS DIRECTLY RELATED TO EATING DISORDERS, SEXUAL DEVIATIONS, PATHOLOGICAL GAMBLING, OR ALCOHOL OR DRUG ABUSE BECAUSE THE PATIENT MAY DERIVE PLEASURE FROM THE ACTIVITY AND MAY WANT TO RESIST IT ONLY BECAUSE OF ITS NEGATIVE CONSEQUENCES.)

NO YES
↓
SKIP TO **G4**

G2 Did they keep coming back into your mind even when you tried to ignore or get rid of them?

NO YES
↓
SKIP TO **G4**

G3 Do you think that these obsessions are the product of your own mind and that they are not imposed from the outside?

NO YES
obsessions

G4 In the past month, did you do something repeatedly without being able to resist doing it, like washing or cleaning excessively, counting or checking things over and over, or repeating, collecting, arranging things, or other superstitious rituals?

NO YES
compulsions

➡

IS **G3** OR **G4** CODED **YES**?

NO YES

➡

G5 At any point, did you recognize that either these obsessive thoughts or these compulsive behaviors were excessive or unreasonable?

NO YES

G6 In the past month, did these obsessive thoughts and/or compulsive behaviors significantly interfere with your normal routine, your work or school, your usual social activities, or relationships, or did they take more than one hour a day?

NO **YES**

O.C.D. CURRENT

H. POSTTRAUMATIC STRESS DISORDER

(➡ MEANS : GO TO THE DIAGNOSTIC BOX, CIRCLE NO, AND MOVE TO THE NEXT MODULE)

H1	Have you ever experienced or witnessed or had to deal with an extremely traumatic event that included actual or threatened death or serious injury to you or someone else? EXAMPLES OF TRAUMATIC EVENTS INCLUDE: SERIOUS ACCIDENTS, SEXUAL OR PHYSICAL ASSAULT, A TERRORIST ATTACK, BEING HELD HOSTAGE, KIDNAPPING, FIRE, DISCOVERING A BODY, WAR, OR NATURAL DISASTER, WITNESSING THE VIOLENT OR SUDDEN DEATH OF SOMEONE CLOSE TO YOU, OR A LIFE THREATENING ILLNESS.	➡ NO	YES
H2	Did you respond with intense fear, helplessness or horror?	➡ NO	YES
H3	During the past month, have you re-experienced the event in a distressing way (such as in dreams, intense recollections, flashbacks or physical reactions) or did you have intense distress when you were reminded about the event or exposed to a similar event?	➡ NO	YES

H4	**In the past month:**			
	a	Have you avoided thinking about or talking about the event ?	NO	YES
	b	Have you avoided activities, places or people that remind you of the event?	NO	YES
	c	Have you had trouble recalling some important part of what happened?	NO	YES
	d	Have you become much less interested in hobbies or social activities?	NO	YES
	e	Have you felt detached or estranged from others?	NO	YES
	f	Have you noticed that your feelings are numbed?	NO	YES
	g	Have you felt that your life will be shortened or that you will die sooner than other people?	NO	YES
		ARE **3** OR MORE **H4** ANSWERS CODED **YES**?	➡ NO	YES
H5	**In the past month:**			
	a	Have you had difficulty sleeping?	NO	YES
	b	Were you especially irritable or did you have outbursts of anger?	NO	YES
	c	Have you had difficulty concentrating?	NO	YES
	d	Were you nervous or constantly on your guard?	NO	YES
	e	Were you easily startled?	NO	YES
		ARE **2** OR MORE **H5** ANSWERS CODED **YES**?	➡ NO	YES

H6	During the past month, have these problems significantly interfered with your work, school or social activities, or caused significant distress?	**NO** **YES** ***POSTTRAUMATIC STRESS DISORDER CURRENT***

I. ALCOHOL DEPENDENCE / ABUSE

(➡ MEANS: GO TO DIAGNOSTIC BOXES, CIRCLE NO IN BOTH AND MOVE TO THE NEXT MODULE)

		➡	
I1	**In the past 12 months**, have you had 3 or more alcoholic drinks, - within a 3 hour period, - on 3 or more occasions?	NO	YES

I2 **In the past 12 months**:

a	Did you need to drink a lot more in order to get the same effect that you got when you first started drinking or did you get much less effect with continued use of the same amount?	NO	YES
b	When you cut down on drinking did your hands shake, did you sweat or feel agitated? Did you drink to avoid these symptoms (for example, "the shakes", sweating or agitation) or to avoid being hungover? IF **YES** TO ANY, CODE **YES**.	NO	YES
c	During the times when you drank alcohol, did you end up drinking more than you planned when you started?	NO	YES
d	Have you tried to reduce or stop drinking alcohol but failed?	NO	YES
e	On the days that you drank, did you spend substantial time in obtaining alcohol, drinking, or in recovering from the effects of alcohol?	NO	YES
f	Did you spend less time working, enjoying hobbies, or being with others because of your drinking?	NO	YES
g	If your drinking caused you health or mental problems, did you still keep on drinking?	NO	YES

ARE **3** OR MORE **I2** ANSWERS CODED **YES**?

NO **YES***

***** IF YES, SKIP I3 QUESTIONS AND GO TO NEXT MODULE. "DEPENDENCE PREEMPTS ABUSE" IN DSM IV TR.

ALCOHOL DEPENDENCE
CURRENT

I3 **In the past 12 months:**

a	Have you been intoxicated, high, or hungover more than once when you had other responsibilities at school, at work, or at home? Did this cause any problems? (CODE **YES** ONLY IF THIS CAUSED PROBLEMS.)	NO	YES
b	Were you intoxicated more than once in any situation where you were physically at risk, for example, driving a car, riding a motorbike, using machinery, boating, etc.?	NO	YES
c	Did you have legal problems more than once because of your drinking, for example, an arrest or disorderly conduct?	NO	YES
d	If your drinking caused problems with your family or other people, did you still keep on drinking?	NO	YES

ARE **1** OR MORE **I3** ANSWERS CODED **YES**?

NO **YES**

ALCOHOL ABUSE
CURRENT

J. SUBSTANCE DEPENDENCE / ABUSE (NON-ALCOHOL)

(➡ MEANS : GO TO THE DIAGNOSTIC BOXES, CIRCLE NO IN ALL DIAGNOSTIC BOXES, AND MOVE TO THE NEXT MODULE)

Now I am going to show you / read to you a list of street drugs or medicines.

			➡	
J1	a	**In the past 12 months**, did you take any of these drugs more than once, to get high, to feel elated, to get "a buzz" or to change your mood?	NO	YES

CIRCLE EACH DRUG TAKEN:

Stimulants: amphetamines, "speed", crystal meth, "crank", "rush", Dexedrine, Ritalin, diet pills.

Cocaine: snorting, IV, freebase, crack, "speedball".

Narcotics: heroin, morphine, Dilaudid, opium, Demerol, methadone, Darvon, codeine, Percodan, Vicoden, OxyContin.

Hallucinogens: LSD ("acid"), mescaline, peyote, psilocybin, STP, "mushrooms", "ecstasy", MDA, MDMA.

Phencyclidine: PCP ("Angel Dust", "PeaCe Pill", "Tranq", "Hog"), or ketamine ("special K").

Inhalants: "glue", ethyl chloride, "rush", nitrous oxide ("laughing gas"), amyl or butyl nitrate ("poppers").

Cannabis: marijuana, hashish ("hash"), THC, "pot", "grass", "weed", "reefer".

Tranquilizers: Quaalude, Seconal ("reds"), Valium, Xanax, Librium, Ativan, Dalmane, Halcion, barbiturates, Miltown, GHB, Roofinol, "Roofies".

Miscellaneous: steroids, nonprescription sleep or diet pills. Cough Medicine? Any others?

SPECIFY THE MOST USED DRUG(S): _____

WHICH DRUG(S) CAUSE THE BIGGEST PROBLEMS?: _____

FIRST EXPLORE THE DRUG CAUSING THE BIGGEST PROBLEMS AND MOST LIKELY TO MEET DEPENDENCE / ABUSE CRITERIA.

IF MEETS CRITERIA FOR ABUSE OR DEPENDENCE, SKIP TO THE NEXT MODULE. OTHERWISE, EXPLORE THE NEXT MOST PROBLEMATIC DRUG.

J2 **Considering your use of (NAME THE DRUG / DRUG CLASS SELECTED), in the past 12 months:**

	a	Have you found that you needed to use much more (NAME OF DRUG / DRUG CLASS SELECTED) to get the same effect that you did when you first started taking it?	NO	YES
	b	When you reduced or stopped using (NAME OF DRUG / DRUG CLASS SELECTED), did you have withdrawal symptoms (aches, shaking, fever, weakness, diarrhea, nausea, sweating, heart pounding, difficulty sleeping, or feeling agitated, anxious, irritable, or depressed)? Did you use any drug(s) to keep yourself from getting sick (withdrawal symptoms) or so that you would feel better?	NO	YES
		IF **YES** TO EITHER, CODE **YES**.		
	c	Have you often found that when you used (NAME OF DRUG / DRUG CLASS SELECTED), you ended up taking more than you thought you would?	NO	YES
	d	Have you tried to reduce or stop taking (NAME OF DRUG / DRUG CLASS SELECTED) but failed?	NO	YES
	e	On the days that you used (NAME OF DRUG / DRUG CLASS SELECTED), did you spend substantial time (>2 HOURS), obtaining, using or in recovering from the drug, or thinking about the drug?	NO	YES
	f	Did you spend less time working, enjoying hobbies, or being with family or friends because of your drug use?	NO	YES
	g	If (NAME OF DRUG / DRUG CLASS SELECTED) caused you health or mental problems, did you still keep on using it?	NO	YES

ARE **3** OR MORE **J2** ANSWERS CODED **YES**?

SPECIFY DRUG(S): _____

***** IF YES, SKIP J3 QUESTIONS, MOVE TO NEXT DISORDER.
"DEPENDENCE PREEMPTS ABUSE" IN DSM IV TR.

NO **YES ***

SUBSTANCE DEPENDENCE
CURRENT

Considering your use of (NAME THE DRUG CLASS SELECTED), in the past 12 months:

J3 a Have you been intoxicated, high, or hungover from (NAME OF DRUG / DRUG CLASS SELECTED) more than once, when you had other responsibilities at school, at work, or at home? Did this cause any problem? NO YES

(CODE **YES** ONLY IF THIS CAUSED PROBLEMS.)

b Have you been high or intoxicated from (NAME OF DRUG / DRUG CLASS SELECTED) more than once in any situation where you were physically at risk (for example, driving a car, riding a motorbike, using machinery, boating, etc.)? NO YES

c Did you have legal problems more than once because of your drug use, for example, an arrest or disorderly conduct? NO YES

d If (NAME OF DRUG / DRUG CLASS SELECTED) caused problems with your family or other people, did you still keep on using it? NO YES

ARE **1** OR MORE **J3** ANSWERS CODED **YES**?

SPECIFY DRUG(S): _____

NO **YES**

SUBSTANCE ABUSE
CURRENT

K. PSYCHOTIC DISORDERS AND MOOD DISORDER WITH PSYCHOTIC FEATURES

ASK FOR AN EXAMPLE OF EACH QUESTION ANSWERED POSITIVELY. CODE **YES** ONLY IF THE EXAMPLES CLEARLY SHOW A DISTORTION OF THOUGHT OR OF PERCEPTION OR IF THEY ARE NOT CULTURALLY APPROPRIATE. BEFORE CODING, INVESTIGATE WHETHER DELUSIONS QUALIFY AS "BIZARRE".

DELUSIONS ARE "BIZARRE" IF: CLEARLY IMPLAUSIBLE, ABSURD, NOT UNDERSTANDABLE, AND CANNOT DERIVE FROM ORDINARY LIFE EXPERIENCE.
HALLUCINATIONS ARE SCORED "BIZARRE" IF: A VOICE COMMENTS ON THE PERSON'S THOUGHTS OR BEHAVIOR, OR WHEN TWO OR MORE VOICES ARE CONVERSING WITH EACH OTHER.
THE PURPOSE OF THIS MODULE IS TO EXCLUDE PATIENTS WITH PSYCHOTIC DISORDERS. THIS MODULE NEEDS EXPERIENCE.

		Now I am going to ask you about unusual experiences that some people have.			BIZARRE
K1	a	Have you ever believed that people were spying on you, or that someone was plotting against you, or trying to hurt you? **NOTE**: ASK FOR EXAMPLES TO RULE OUT ACTUAL STALKING.	NO	YES	YES
	b	**IF YES OR YES BIZARRE:** do you currently believe these things?	NO	YES	YES ↳**K6**
K2	a	Have you ever believed that someone was reading your mind or could hear your thoughts, or that you could actually read someone's mind or hear what another person was thinking?	NO	YES	YES
	b	**IF YES OR YES BIZARRE:** do you currently believe these things?	NO	YES	YES ↳**K6**
K3	a	Have you ever believed that someone or some force outside of yourself put thoughts in your mind that were not your own, or made you act in a way that was not your usual self? Have you ever felt that you were possessed? CLINICIAN: ASK FOR EXAMPLES AND DISCOUNT ANY THAT ARE NOT PSYCHOTIC.	NO	YES	YES
	b	**IF YES OR YES BIZARRE:** do you currently believe these things?	NO	YES	YES ↳**K6**
K4	a	Have you ever believed that you were being sent special messages through the TV, radio, newspapers, books or magazines or that a person you did not personally know was particularly interested in you?	NO	YES	YES
	b	**IF YES OR YES BIZARRE:** do you currently believe these things?	NO	YES	YES ↳**K6**
K5	a	Have your relatives or friends ever considered any of your beliefs odd or unusual? INTERVIEWER**:** ASK FOR EXAMPLES. ONLY CODE **YES** IF THE EXAMPLES ARE **CLEARLY** DELUSIONAL IDEAS NOT EXPLORED IN QUESTIONS K1 TO K4, FOR EXAMPLE, SOMATIC OR RELIGIOUS DELUSIONS OR DELUSIONS OF GRANDIOSITY, JEALOUSY, GUILT, RUIN OR DESTITUTION, ETC.	NO	YES	YES
	b	**IF YES OR YES BIZARRE:** do they currently consider your beliefs strange?	NO	YES	YES
K6	a	Have you ever heard things other people couldn't hear, such as voices?	NO	YES	
		IF YES TO VOICE HALLUCINATION: Was the voice commenting on your thoughts or behavior or did you hear two or more voices talking to each other?	NO		YES
	b	**IF YES OR YES BIZARRE TO K6a:** have you heard sounds / voices in the past month?	NO	YES	
		IF YES TO VOICE HALLUCINATION: Was the voice commenting on your thoughts or behavior or did you hear two or more voices talking to each other?	NO		YES ↳**K8b**

K7 a Have you ever had visions when you were awake or have you ever seen things other people couldn't see? NO YES

CLINICIAN: CHECK TO SEE IF THESE ARE CULTURALLY INAPPROPRIATE.

b **IF YES:** have you seen these things in the past month? NO YES

CLINICIAN'S JUDGMENT

K8 b IS THE PATIENT CURRENTLY EXHIBITING INCOHERENCE, DISORGANIZED SPEECH, OR MARKED LOOSENING OF ASSOCIATIONS? NO YES

K9 b IS THE PATIENT CURRENTLY EXHIBITING DISORGANIZED OR CATATONIC BEHAVIOR? NO YES

K10 b ARE NEGATIVE SYMPTOMS OF SCHIZOPHRENIA, E.G. SIGNIFICANT AFFECTIVE FLATTENING, POVERTY OF SPEECH (ALOGIA) OR AN INABILITY TO INITIATE OR PERSIST IN GOAL-DIRECTED ACTIVITIES (AVOLITION), PROMINENT DURING THE INTERVIEW? NO YES

K11 a ARE 1 OR MORE « a » QUESTIONS FROM K1a TO K7a CODED **YES OR YES BIZARRE** AND IS EITHER:

MAJOR DEPRESSIVE EPISODE, (CURRENT, RECURRENT OR PAST)
OR
MANIC OR HYPOMANIC EPISODE, (CURRENT OR PAST) CODED **YES**? NO YES
↳ **K13**

IF NO TO K11 a, CIRCLE NO IN BOTH 'MOOD DISORDER WITH PSYCHOTIC FEATURES' DIAGNOSTIC BOXES AND MOVE TO K13.

b You told me earlier that you had period(s) when you felt (depressed/high/persistently irritable).

Were the beliefs and experiences you just described (SYMPTOMS CODED **YES** FROM **K1**a TO **K7**a) restricted exclusively to times when you were feeling depressed/high/irritable?

IF THE PATIENT EVER HAD A PERIOD OF AT LEAST 2 WEEKS OF HAVING THESE BELIEFS OR EXPERIENCES (PSYCHOTIC SYMPTOMS) WHEN THEY WERE NOT DEPRESSED/HIGH/IRRITABLE, CODE NO TO THIS DISORDER.

IF THE ANSWER IS NO TO THIS DISORDER, ALSO CIRCLE NO TO K12 AND MOVE TO K13

NO **YES**

MOOD DISORDER WITH *PSYCHOTIC FEATURES*

LIFETIME

K12 a ARE 1 OR MORE « b » QUESTIONS FROM K1b TO K7b CODED **YES OR YES BIZARRE** AND IS EITHER:

MAJOR DEPRESSIVE EPISODE, (CURRENT)
OR
MANIC OR HYPOMANIC EPISODE, (CURRENT) CODED **YES**?

IF THE ANSWER IS YES TO THIS DISORDER (LIFETIME OR CURRENT), CIRCLE NO TO K13 AND K14 AND MOVE TO THE NEXT MODULE.

NO **YES**

MOOD DISORDER WITH *PSYCHOTIC FEATURES*

CURRENT

K13 ARE 1 OR MORE « b » QUESTIONS FROM K1b TO K6b, CODED **YES BIZARRE**?

OR

ARE 2 OR MORE « b » QUESTIONS FROM K1b TO K10b, CODED **YES** (RATHER THAN **YES BIZARRE**)?

AND DID AT LEAST TWO OF THE PSYCHOTIC SYMPTOMS OCCUR DURING THE SAME 1 MONTH PERIOD?

NO **YES**

PSYCHOTIC DISORDER
CURRENT

K14 IS **K13** CODED **YES**

OR

ARE 1 OR MORE « a » QUESTIONS FROM K1a TO K6a, CODED **YES BIZARRE**?

OR

ARE 2 OR MORE « a » QUESTIONS FROM K1a TO K7a, CODED **YES** (RATHER THAN **YES BIZARRE**)

AND DID AT LEAST TWO OF THE PSYCHOTIC SYMPTOMS OCCUR DURING THE SAME 1 MONTH PERIOD?

NO **YES**

PSYCHOTIC DISORDER
LIFETIME

L. ANOREXIA NERVOSA

(➡ MEANS : GO TO THE DIAGNOSTIC BOX, CIRCLE NO, AND MOVE TO THE NEXT MODULE)

L1	a	How tall are you?	❑ ft ❑❑ in. ❑❑❑ cm.
	b.	What was your lowest weight in the past 3 months?	❑❑❑ lbs. ❑❑❑ kgs.
	c	IS PATIENT'S WEIGHT EQUAL TO OR BELOW THE THRESHOLD CORRESPONDING TO HIS / HER HEIGHT? (SEE TABLE BELOW)	➡ NO YES

In the past 3 months:

L2		In spite of this low weight, have you tried not to gain weight?	➡ NO YES
L3		Have you intensely feared gaining weight or becoming fat, even though you were underweight?	➡ NO YES
L4	a	Have you considered yourself too big / fat or that part of your body was too big / fat?	NO YES
	b	Has your body weight or shape greatly influenced how you felt about yourself?	NO YES
	c	Have you thought that your current low body weight was normal or excessive?	NO YES
L5		ARE 1 OR MORE ITEMS FROM **L4** CODED **YES**?	➡ NO YES
L6		FOR WOMEN ONLY: During the last 3 months, did you miss all your menstrual periods when they were expected to occur (when you were not pregnant)?	➡ NO YES

FOR WOMEN: ARE **L5 AND L6** CODED **YES**?

FOR MEN: IS **L5** CODED **YES**?

NO YES

ANOREXIA NERVOSA
CURRENT

HEIGHT / WEIGHT TABLE CORRESPONDING TO A BMI THRESHOLD OF 17.5 KG/M^2

Height/Weight														
ft/in	4'9	4'10	4'11	5'0	5'1	5'2	5'3	5'4	5'5	5'6	5'7	5'8	5'9	5'10
lbs.	81	84	87	89	92	96	99	102	105	108	112	115	118	122
cm	145	147	150	152	155	158	160	163	165	168	170	173	175	178
kgs	37	38	39	41	42	43	45	46	48	49	51	52	54	55

Height/Weight					
ft/in	5'11	6'0	6'1	6'2	6'3
lbs.	125	129	132	136	140
cm	180	183	185	188	191
kgs	57	59	60	62	64

The weight thresholds above are calculated using a body mass index (BMI) equal to or below 17.5 kg/m^2 for the patient's height. This is the threshold guideline below which a person is deemed underweight by the DSM-IV and the ICD-10 Diagnostic Criteria for Research for Anorexia Nervosa.

M. BULIMIA NERVOSA

(➡ MEANS : GO TO THE DIAGNOSTIC BOXES, CIRCLE NO IN ALL DIAGNOSTIC BOXES, AND MOVE TO THE NEXT MODULE)

M1	In the past three months, did you have eating binges or times when you ate a very large amount of food within a 2-hour period?	➡ NO	YES
M2	In the last 3 months, did you have eating binges as often as twice a week?	➡ NO	YES
M3	During these binges, did you feel that your eating was out of control?	➡ NO	YES
M4	Did you do anything to compensate for, or to prevent a weight gain from these binges, like vomiting, fasting, exercising or taking laxatives, enemas, diuretics (fluid pills), or other medications?	➡ NO	YES
M5	Does your body weight or shape greatly influence how you feel about yourself?	➡ NO	YES
M6	DO THE PATIENT'S SYMPTOMS MEET CRITERIA FOR ANOREXIA NERVOSA?	NO	YES ↓ Skip to M8
M7	Do these binges occur only when you are under (____lbs./kgs.)? INTERVIEWER: WRITE IN THE ABOVE PARENTHESIS THE THRESHOLD WEIGHT FOR THIS PATIENT'S HEIGHT FROM THE HEIGHT / WEIGHT TABLE IN THE ANOREXIA NERVOSA MODULE.	NO	YES

M8 IS **M5** CODED **YES** AND IS EITHER **M6** OR **M7** CODED **NO**?

NO **YES**

BULIMIA NERVOSA
CURRENT

IS **M7** CODED **YES**?

NO **YES**

ANOREXIA NERVOSA
Binge Eating/Purging Type
CURRENT

N. GENERALIZED ANXIETY DISORDER

(➡ MEANS : GO TO THE DIAGNOSTIC BOX, CIRCLE NO, AND MOVE TO THE NEXT MODULE)

N1	a	Were you excessively anxious or worried about several routine things, over the past 6 months? IN ENGLISH, IF THE PATIENT IS UNCLEAR ABOUT WHAT YOU MEAN, PROBE BY ASKING (Do others think that you are a "worry wart") AND GET EXAMPLES.	➡ NO	YES
	b	Are these anxieties and worries present most days?	➡ NO	YES
		ARE THE PATIENT'S ANXIETY AND WORRIES RESTRICTED EXCLUSIVELY TO, OR BETTER EXPLAINED BY, ANY DISORDER PRIOR TO THIS POINT?	NO	➡ YES
N2		Do you find it difficult to control the worries?	➡ NO	YES
N3		FOR THE FOLLOWING, CODE **NO** IF THE SYMPTOMS ARE CONFINED TO FEATURES OF ANY DISORDER EXPLORED PRIOR TO THIS POINT**.**		
		When you were anxious over the past 6 months, did you, most of the time:		
	a	Feel restless, keyed up or on edge?	NO	YES
	b	Have muscle tension?	NO	YES
	c	Feel tired, weak or exhausted easily?	NO	YES
	d	Have difficulty concentrating or find your mind going blank?	NO	YES
	e	Feel irritable?	NO	YES
	f	Have difficulty sleeping (difficulty falling asleep, waking up in the middle of the night, early morning wakening or sleeping excessively)?	NO	YES
		ARE **3** OR MORE **N3** ANSWERS CODED **YES?**	➡ NO	YES
N4		Do these anxieties and worries disrupt your normal work, school or social functioning or cause you significant distress?	**NO**	**YES**

GENERALIZED ANXIETY DISORDER
CURRENT

O. RULE OUT MEDICAL, ORGANIC OR DRUG CAUSES FOR ALL DISORDERS

IF THE PATIENT CODES POSITIVE FOR ANY CURRENT DISORDER ASK:

Just before these symptoms began:

O1a	Were you taking any drugs or medicines?	❒ No	❒ Yes	❒ Uncertain
O1b	Did you have any medical illness?	❒ No	❒ Yes	❒ Uncertain

IN THE CLINICIAN'S JUDGMENT: ARE EITHER OF THESE LIKELY TO BE DIRECT CAUSES OF THE PATIENT'S DISORDER?
IF NECESSARY ASK ADDITIONAL OPEN-ENDED QUESTIONS.

O2	**SUMMARY**: HAS AN ORGANIC CAUSE BEEN RULED OUT?	❒ No	❒ Yes	❒ Uncertain

P. ANTISOCIAL PERSONALITY DISORDER

(➡ MEANS : GO TO THE DIAGNOSTIC BOX AND CIRCLE NO)

P1 **Before you were 15 years old, did you:**

a	repeatedly skip school or run away from home overnight?	NO	YES
b	repeatedly lie, cheat, "con" others, or steal?	NO	YES
c	start fights or bully, threaten, or intimidate others?	NO	YES
d	deliberately destroy things or start fires?	NO	YES
e	deliberately hurt animals or people?	NO	YES
f	force someone to have sex with you?	NO	YES

➡

ARE **2** OR MORE **P1** ANSWERS CODED **YES**? NO YES

DO NOT CODE **YES** TO THE BEHAVIORS BELOW IF THEY ARE EXCLUSIVELY POLITICALLY OR RELIGIOUSLY MOTIVATED**.**

P2 **Since you were 15 years old, have you:**

a	repeatedly behaved in a way that others would consider irresponsible, like failing to pay for things you owed, deliberately being impulsive or deliberately not working to support yourself?	NO	YES
b	done things that are illegal even if you didn't get caught (for example, destroying property, shoplifting, stealing, selling drugs, or committing a felony)?	NO	YES
c	been in physical fights repeatedly (including physical fights with your spouse or children)?	NO	YES
d	often lied or "conned" other people to get money or pleasure, or lied just for fun?	NO	YES
e	exposed others to danger without caring?	NO	YES
f	felt no guilt after hurting, mistreating, lying to, or stealing from others, or after damaging property?	NO	YES

ARE **3** OR MORE **P2** QUESTIONS CODED **YES**?

NO **YES**

ANTISOCIAL PERSONALITY DISORDER
LIFETIME

THIS CONCLUDES THE INTERVIEW

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Translations	**M.I.N.I. 4.4 or earlier versions**	**M.I.N.I. 4.6/5.0, M.I.N.I. Plus 4.6/5.0 and M.I.N.I. Screen 5.0:**
Afrikaans	R. Emsley, W. Maartens	
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Portuguese	P. Amorim	P. Amorim, T. Guterres
Punjabi		A. Gahunia, S. Gambhir
Romanian		O. Driga
Russian		A. Bystritsky, E. Selivra, M. Bystritsky, L. Shumyak, M. Klisinska.
Serbian	I. Timotijevic	I. Timotijevic
Setswana	K. Ketlogetswe	
Slovenian	M. Kocmur	
Spanish	L. Ferrando, J. Bobes-Garcia, J. Gilbert-Rahola, Y. Lecrubier	L. Ferrando, L. Franco-Alfonso, M. Soto, J. Bobes-Garcia, O. Soto, L. Franco, G. Heinze, C. Santana, R. Hidalgo
Swedish	M. Waern, S. Andersch, M. Humble	C. Allgulander, H. Agren M. Waern, A. Brimse, M. Humble.
Tamil		Organon
Telugu		Organon
Thai		P. Kittirattanapaiboon, S. Mahatnirunkul, P. Udomrat, P. Silpakit,, M. Khamwongpin, S. Srikosai.
Turkish	T. Örnek, A. Keskiner, I. Vahip	T. Örnek, A. Keskiner, A.Engeler
Urdu		S. Gambhir
Yiddish		J. Goldman, Chana Pollack, Myrna Mniewski

A validation study of this instrument was made possible, in part, by grants from SmithKline Beecham and the European Commission.
The authors are grateful to Dr. Pauline Powers for her advice on the modules on Anorexia Nervosa and Bulimia.

MOOD DISORDERS: DIAGNOSTIC ALGORITHM

Consult Modules:
- A Major Depressive Episode
- C (Hypo) manic Episode
- K Psychotic Disorders

MODULE K:

1a	IS **K11b** CODED YES?	NO	YES
1b	IS **K12a** CODED YES?	NO	YES

MODULES A and C:		Current	Past
2 a	CIRCLE YES IF A DELUSIONAL IDEA IS IDENTIFIED IN **A3e**?	YES	YES
b	CIRCLE YES IF A DELUSIONAL IDEA IS IDENTIFIED IN **C3a**?	YES	YES

c Is a Major Depressive Episode coded YES (current or past)?
and
is Manic Episode coded NO (current and past)?
and
is Hypomanic Episode coded NO (current and past)?
and
is **"**Hypomanic Symptoms" coded NO (current and past)?

Specify:
- If the depressive episode is **current** or **past** or both
- **With Psychotic Features** Current: If 1b or 2a (current) = YES
  With Psychotic Features Past: If 1a or 2a (past) = YES

MAJOR DEPRESSIVE DISORDER

	current	past
MDD	❑	❑

With Psychotic Features

Current	❑
Past	❑

d Is a Manic Episode coded YES (current or past)?

Specify:
- If the Bipolar I Disorder is **current** or **past** or both
- With **Single Manic Episode**: If Manic episode (current or past) = YES
  and MDE (current and past) = NO
- **With Psychotic Features** Current: If 1b or 2a (current) or 2b (current) = YES
  With Psychotic Features Past: If 1a or 2a (past) or 2b (past) = YES
- If the **most recent episode** is manic, depressed,
  mixed or hypomanic or unspecified (all mutually exclusive)
- **Unspecified** if the Past Manic Episode is coded YES AND
  Current (C3 Summary AND C4a AND C6 AND O2) are coded YES

BIPOLAR I DISORDER

	current	past
Bipolar I Disorder	❑	❑
Single Manic Episode	❑	❑

With Psychotic Features

Current	❑
Past	❑

Most Recent Episode

Manic	❑
Depressed	❑
Mixed	❑
Hypomanic	❑
Unspecified	❑

e Is Major Depressive Episode coded YES (current or past)?
and
Is Hypomanic Episode coded YES (current or past)?
and
Is Manic Episode coded NO (current and past)?

Specify:

- If the Bipolar Disorder is **current** or **past** or both
- If the most recent mood episode is **hypomanic** or **depressed** (mutually exclusive)

BIPOLAR II DISORDER

	current	past
Bipolar II Disorder	❑	❑

Most Recent Episode

Hypomanic	❑
Depressed	❑

f Is MDE coded NO (current and past)
and
Is Manic Episode coded NO (current and past)?
and is either:

1) C7b coded YES for the appropriate time frame?

or

2) C3 Summary coded YES for the appropriate time frame?
and
C4a coded YES for the appropriate time frame?
and
C7c coded YES for the appropriate time frame?

Specify if the Bipolar Disorder NOS is **current** or **past** or both

BIPOLAR DISORDER NOS

	current	past
Bipolar Disorder NOS	❑	❑

M.I.N.I. PLUS

The shaded modules below are additional modules available in the MINI PLUS beyond what is available in the standard MINI. The un-shaded modules below are in the standard MINI.

These MINI PLUS modules can be inserted into or used in place of the standard MINI modules, as dictated by the specific needs of any study.

	MODULES	TIME FRAME
A	MAJOR DEPRESSIVE EPISODE	Current (2 weeks) Past Recurrent
	MOOD DISORDER DUE TO A GENERAL MEDICAL CONDITION	Current Past
	SUBSTANCE INDUCED MOOD DISORDER	Current Past
	MDE WITH MELANCHOLIC FEATURES	Current (2 weeks)
	MDE WITH ATYPICAL FEATURES	Current (2 weeks)
	MDE WITH CATATONIC FEATURES	Current (2 weeks)
B	DYSTHYMIA	Current (Past 2 years) Past
C	SUICIDALITY	Current (Past Month) Risk: ❑ Low ❑ Medium ❑ High
D	MANIC EPISODE	Current Past
	HYPOMANIC EPISODE	Current Past
	BIPOLAR I DISORDER	Current Past
	BIPOLAR II DISORDER	Current Past
	BIPOLAR DISORDER NOS	Current Past
	MANIC EPISODE DUE TO A GENERAL MEDICAL CONDITION	Current Past
	HYPOMANIC EPISODE DUE TO A GENERAL MEDICAL CONDITION	Current Past
	SUBSTANCE INDUCED MANIC EPISODE	Current Past
	SUBSTANCE INDUCED HYPOMANIC EPISODE	Current Past
E	PANIC DISORDER	Current (Past Month) Lifetime
	ANXIETY DISORDER WITH PANIC ATTACKS DUE TO A GENERAL MEDICAL CONDITION	Current
	SUBSTANCE INDUCED ANXIETY DISORDER WITH PANIC ATTACKS	Current
F	AGORAPHOBIA	Current
G	SOCIAL PHOBIA (Social Anxiety Disorder)	Current (Past Month)
H	SPECIFIC PHOBIA	Current
I	OBSESSIVE-COMPULSIVE DISORDER	Current (Past Month)
	OCD DUE TO A GENERAL MEDICAL CONDITION	Current
	SUBSTANCE INDUCED OCD	Current
J	POSTTRAUMATIC STRESS DISORDER	Current (Past Month)
K	ALCOHOL DEPENDENCE	Past 12 Months
	ALCOHOL DEPENDENCE	Lifetime
	ALCOHOL ABUSE	Past 12 Months
	ALCOHOL ABUSE	Lifetime
L	SUBSTANCE DEPENDENCE (Non-alcohol)	Past 12 Months
	SUBSTANCE DEPENDENCE (Non-alcohol)	Lifetime
	SUBSTANCE ABUSE (Non-alcohol)	Past 12 Months

M	PSYCHOTIC DISORDERS	Lifetime
		Current
	MOOD DISORDER WITH PSYCHOTIC FEATURES	Current
	SCHIZOPHRENIA	Current
		Lifetime
	SCHIZOAFFECTIVE DISORDER	Current
		Lifetime
	SCHIZOPHRENIFORM DISORDER	Current
		Lifetime
	BRIEF PSYCHOTIC DISORDER	Current
		Lifetime
	DELUSIONAL DISORDER	Current
		Lifetime
	PSYCHOTIC DISORDER DUE TO A GENERAL MEDICAL CONDITION	Current
		Lifetime
	SUBSTANCE INDUCED PSYCHOTIC DISORDER	Current
		Lifetime
	PSYCHOTIC DISORDER NOS	Current
		Lifetime
	MOOD DISORDER WITH PSYCHOTIC FEATURES	Lifetime
	MOOD DISORDER NOS	Lifetime
	MAJOR DEPRESSIVE DISORDER WITH PSYCHOTIC FEATURES	Current
		Past
	BIPOLAR I DISORDER WITH PSYCHOTIC FEATURES	Current
		Past
N	ANOREXIA NERVOSA	Current (Past 3 Months)
O	BULIMIA NERVOSA	Current (Past 3 Months)
	BULIMIA NERVOSA PURGING TYPE	Current
	BULIMIA NERVOSA NONPURGING TYPE	Current
	ANOREXIA NERVOSA, BINGE EATING/PURGING TYPE	Current
	ANOREXIA NERVOSA, RESTRICTING TYPE	Current
P	GENERALIZED ANXIETY DISORDER	Current (Past 6 Months)
	GENERALIZED ANXIETY DISORDER DUE TO A GENERAL MEDICAL CONDITION	Current
	SUBSTANCE INDUCED GAD	Current
Q	ANTISOCIAL PERSONALITY DISORDER	Lifetime
R	SOMATIZATION DISORDER	Lifetime
		Current
S	HYPOCHONDRIASIS	Current
T	BODY DYSMORPHIC DISORDER	Current
U	PAIN DISORDER	Current
V	CONDUCT DISORDER	Past 12 Months
W	ATTENTION DEFICIT/HYPERACTIVITY DISORDER (Children/Adolescents)	Past 6 Months
	ATTENTION DEFICIT/HYPERACTIVITY DISORDER (Adults)	Lifetime
		Current
X	ADJUSTMENT DISORDERS	Current
Y	PREMENSTRUAL DYSPHORIC DISORDER	Current
Z	MIXED ANXIETY-DEPRESSIVE DISORDER	Current

EDINBURGH HANDEDNESS SURVEY

Subject ID#:_____

Date: _____

Please indicate your preferences in the use of hands in the following activities by putting a + in the appropriate column. Where the preference is so strong that you would never try to use the other hand unless absolutely forced to, put ++. If in any case you are really indifference put + in both columns.

Some of the activities require both hands. In these cases the part of the task, or object, for which the hand preference is wanted is indicated in brackets.

Please try to answer all the questions, and only leave a blank if you have no experience at all of the object or task.

		LEFT	RIGHT
1	Writing		
2	Drawing		
3	Throwing		
4	Scissors		
5	Toothbrush		
6	Knife [without fork]		
7	Spoon		
8	Broom [upper hand]		
9	Striking Match [match]		
10	Opening Box [lid]		

Do not write below this line

L.Q.:_____ DECILE: _____

Personality Assessment Inventory (PAI)

Personality Assessment Inventory™ (PAI®)

Leslie C. Morey, PhD

Revised and updated materials help increase the accuracy of personality assessment.

Purpose: 22 nonoverlapping full scales provide a comprehensive assessment of adult psychopathology in ages 18 years and older

Age Range: Adult
Elder Adult

Admin: Individual or group

Time: 50-60 minutes to administer; 15-20 minutes to score

Qualification: C

Sample Reports: N/A

Related Products: PAI® Professional Report Service
PAI® Software Portfolio
Personality Assessment Inventory™-Adolescent

With its newly revised Professional Manual, Profile Form Adults-Revised, and Critical Items Form-Revised, the PAI® continues to raise the standard for the assessment of adult psychopathology. This objective inventory of adult personality assesses psychopathological syndromes and provides information relevant for clinical diagnosis, treatment planning, and screening for psychopathology. Since its introduction, the PAI has been heralded as one of the most important innovations in the field of clinical assessment.

PAI® Scales and Subscales

The 344 PAI items constitute 22 nonoverlapping scales covering the constructs most relevant to a broad-based assessment of mental disorders: 4 validity scales, 11 clinical scales, 5 treatment scales, and 2 interpersonal scales. To facilitate interpretation and to cover the full range of complex clinical constructs, 10 scales contain conceptually derived subscales.

The PAI Clinical scales were developed to provide information about critical diagnostic features of 11 important clinical constructs. These 11 scales may be divided into three broad classes of disorders: those within the neurotic spectrum, those within the psychotic spectrum, and those associated with behavior disorder or impulse control problems.

The Treatment scales were developed to provide indicators of potential complications in treatment that would not necessarily be apparent from diagnostic information. These five scales include two indicators of potential for harm to self or others, two measures of the respondent's environmental circumstances, and one indicator of the respondent's motivation for treatment.

The Interpersonal scales were developed to provide an assessment of the respondent's interpersonal style along two dimensions: a warmly affiliative versus a cold rejecting style, and a dominating/controlling versus a meekly submissive style. These axes provide a useful way of conceptualizing many different mental disorders: persons at the extremes of these dimensions may present with a variety of disorders. A number of studies provide evidence that diagnostic groups differ on these dimensions.

The PAI includes a Borderline Features scale and an Antisocial Features scale. Both of these scales specifically assess character pathology. The Borderline Features scale is the only PAI scale that has four subscales, reflecting the factorial complexity of the construct. The Antisocial Features scale includes a total of three facets: one assessing antisocial behaviors, and the other two assessing antisocial traits.

WASI-II Record Form

WECHSLER ABBREVIATED SCALE OF INTELLIGENCE® — SECOND EDITION

Calculation of Examinee's Age	Year	Month	Day
Test Date			
Test Age			

ID:

Sex: ☐ F ☐ M Handedness: ☐ R ☐ L

Address/School/Testing Site:

Highest Education/Grade:

Examiner Name:

Total Raw Score to *T* Score Conversion

Subtest	Raw Score	*T* Scores			
Block Design					
Vocabulary					
Matrix Reasoning					
Similarities					
Sum of *T* Scores					
		Verbal Comp.	Perc. Rsng.	Full Scale–4	Full Scale–2

Examinee Visual/Hearing Aids During Testing

Check type of aid examinee needed:	Used	Not Used
☐ Glasses	☐	☐
☐ Prescription Lenses	☐	☐
☐ Assisted Listening Device	☐	☐
☐ Other:	☐	☐

Sum of *T* Scores to Composite Score Conversion

Scale	Sum of *T* Scores	Composite Score	Percentile Rank	Confidence Interval 90% or 95%
Verbal Comp.		VCI		–
Perc. Rsng.		PRI		–
Full Scale–4		FSIQ–4		–
Full Scale–2		FSIQ–2		–

Ranges of Expected Scores

Scores	Confidence Level 90%	68%
FSIQ–4		
WISC-IV FSIQ	–	–
WAIS-IV FSIQ	–	–

Subtest *T* Score Profile

	Verbal Comprehension		Perceptual Reasoning	
	VC	SI	BD	MR
80				
75				
70				
65				
60				
55				
50				
45				
40				
35				
30				
25				
20				

Composite Score Profile

	VCI	PRI	FSIQ
160			
155			
150			
145			
140			
135			
130			
125			
120			
115			
110			
105			
100			
95			
90			
85			
80			
75			
70			
65			
60			
55			
50			
45			
40			

PEARSON

PsychCorp

3 4 5 6 7 8 9 10 11 12 A B C D E 282563-1 3

Product Number 0158981596

1. Block Design

(Time limit: See item)

Start
Ages 6–8: Item 1
Ages 9–90: Item 3

Reverse
Ages 9–90: Does not obtain a perfect score on *either* Item 3 or Item 4, administer the preceding items in reverse order until two consecutive perfect scores are obtained.

Discontinue
After 2 consecutive scores of 0.

Stop
Ages 6–8: After Item 11.

Record & Score
Items 1–4: Score 0, 1, or 2 points.
Items 5–13: Score 0, 4, 5, 6, or 7 points.

		Design	Presentation Method	Time Limit	Completion Time		Constructed Design		Score			
6–8	1.	Examinee / Examiner	Model and Picture	30"	Trial 1	Trial 2	Trial 1	Trial 2	0	1	2	
	2.		Model and Picture	30"	Trial 1	Trial 2	Trial 1	Trial 2	0	1	2	
9–90	3.		Model and Picture	45"	Trial 1	Trial 2	Trial 1	Trial 2	0	1	2	
	4.		Model and Picture	45"	Trial 1	Trial 2	Trial 1	Trial 2	0	1	2	
	5.		Picture	60"					0	21–60: 4	16–20: 5	11–15: 6	1–10: 7
	6.		Picture	60"					0	21–60: 4	16–20: 5	11–15: 6	1–10: 7
	7.		Picture	60"					0	21–60: 4	16–20: 5	11–15: 6	1–10: 7
	8.		Picture	60"					0	21–60: 4	16–20: 5	11–15: 6	1–10: 7
	9.		Picture	120"					0	71–120: 4	46–70: 5	31–45: 6	1–30: 7
	10.		Picture	120"					0	61–120: 4	46–60: 5	36–45: 6	1–35: 7
	11.		Picture	120"					0	61–120: 4	46–60: 5	36–45: 6	1–35: 7
6–8 STOP	12.		Picture	120"					0	61–120: 4	46–60: 5	36–45: 6	1–35: 7
	13.		Picture	120"					0	101–120: 4	81–100: 5	56–80: 6	1–55: 7

Maximum Raw Score
Ages 6–8: 57
Ages 9–90: 71

Block Design Total Raw Score ____

2. Vocabulary

Start
Ages 6–90: Item 4

Reverse
Ages 6–90: Does not obtain a perfect score on *either* Item 4 or Item 5, administer the preceding items in reverse order until two consecutive perfect scores are obtained.

Discontinue
After 3 consecutive scores of 0.

Stop
Age 6: After Item 22.
Ages 7–11: After Item 25.
Ages 12–14: After Item 28.

Record & Score
Items 1–3: Score 0 or 1 point.
Items 4–5: Score 0 or 2 points.
Items 6–31: Score 0, 1, or 2 points.
See the Manual for sample responses.

	Item	Response	Score
	1. Fish		0 1
	2. Shovel		0 1
	3. Shell		0 1
6–90	†4. Shirt		0 2
	5. Car		0 2
	6. Lamp		0 1 2
	7. Bird		0 1 2
	8. Tongue		0 1 2
	9. Pet		0 1 2
	10. Lunch		0 1 2
	11. Bell		0 1 2
	12. Calendar		0 1 2
	13. Alligator		0 1 2
	14. Dance		0 1 2

†If the examinee provides a 2-point response that requires feedback or gives an incorrect (0 point) response, provide corrective feedback as instructed in the Manual.

continue

2. Vocabulary *(continued)*

Discontinue after 3 consecutive scores of 0.

	Item	Response	Score
	15. Summer		0 1 2
	16. Reveal		0 1 2
	17. Decade		0 1 2
	18. Entertain		0 1 2
	19. Tradition		0 1 2
	20. Enthusiastic		0 1 2
	21. Improvise		0 1 2
	22. Haste		0 1 2
6 STOP	23. Trend		0 1 2
	24. Impulse		0 1 2
	25. Ruminate		0 1 2
7–11 STOP	26. Mollify		0 1 2
	27. Extirpate		0 1 2
	28. Panacea		0 1 2
12–14 STOP			

continue

2. Vocabulary *(continued)*

Discontinue after **3** consecutive scores of 0.

Item	Response	Score
29. Perfunctory		0 1 2
30. Insipid		0 1 2
31. Pavid		0 1 2

Maximum Raw Score
Age 6: 41
Ages 7–11: 47
Ages 12–14: 53
Ages 15–90: 59

Vocabulary Total Raw Score ____

3. Matrix Reasoning

Start
Ages 6–8: Sample Items A & B, then Item 1
Ages 9–90: Sample Items A & B, then Item 4

Reverse
Ages 9–90: Does not obtain a perfect score on *either* Item 4 or Item 5, administer the preceding items in **reverse** order until two consecutive perfect scores are obtained.

Discontinue
After **3** consecutive scores of 0.

Stop
Ages 6–8: After Item 24.

Record & Score
Score **0** or **1** point.
Correct responses are in **color**.

	Item	Response					Score	
6–90	SA.	1	**2**	3	4	5		
	SB.	1	2	**3**	4	5		
6–8	1.	1	**2**	3	4	5	0	1
	2.	**1**	2	3	4	5	0	1
	3.	1	2	**3**	4	5	0	1
9–90	4.	**1**	2	3	4	5	0	1
	5.	1	2	3	4	**5**	0	1
	6.	**1**	2	3	4	5	0	1
	7.	1	2	**3**	4	5	0	1
	8.	1	2	**3**	4	5	0	1
	9.	1	2	3	**4**	5	0	1
	10.	1	**2**	3	4	5	0	1
	11.	1	2	**3**	4	5	0	1
	12.	1	2	3	**4**	5	0	1
	13.	**1**	2	3	4	5	0	1
	14.	1	2	3	**4**	5	0	1
	15.	1	**2**	3	4	5	0	1
	16.	1	2	3	4	**5**	0	1
	17.	1	2	3	**4**	5	0	1
	18.	1	**2**	3	4	5	0	1
	19.	1	2	3	**4**	5	0	1
	20.	1	**2**	3	4	5	0	1
	21.	1	2	**3**	4	5	0	1
	22.	1	2	**3**	4	5	0	1
	23.	**1**	2	3	4	5	0	1
6–8 STOP	24.	1	2	3	**4**	5	0	1
	25.	1	2	3	**4**	5	0	1
	26.	1	**2**	3	4	5	0	1
	27.	1	2	3	4	**5**	0	1
	28.	1	2	3	4	**5**	0	1
	29.	**1**	2	3	4	5	0	1
	30.	1	**2**	3	4	5	0	1

Maximum Raw Score
Ages 6–8: 24
Ages 9–90: 30

Matrix Reasoning Total Raw Score ____

4. Similarities

Start
Ages 6–8: Item 1
Ages 9–90: Item 4

Reverse
Ages 9–90: Does not obtain a perfect score on *either* Item 4 or Item 5, administer the preceding items in **reverse** order until two consecutive perfect scores are obtained.

Discontinue
After **3** consecutive scores of 0.

Stop
Ages 6–8: After Item 22.

Record & Score
Items 1–3: Score **0** or **1** point. Correct responses are in **color**.
Items 4–5: Score **0** or **2** points.
Items 6–24: Score **0**, **1**, or **2** points. See Manual for sample responses.

	Picture Item	Response	Score
6–8	†1.	1 2 **3** 4 5	0 1

Picture Item	Response	Score
2.	1 2 3 **4** 5	0 1

Picture Item	Response	Score
3.	1 **2** 3 4 5	0 1

	Verbal Items	Response	Score
9–90	§† 4. Green–Blue		0 2
	§† 5. Square–Triangle		0 2
	6. Cow–Bear		0 1 2
	7. Shirt–Jacket		0 1 2
	8. Pen–Crayon		0 1 2
	9. Hat–Umbrella		0 1 2
	10. Airplane–Bus		0 1 2
	11. Door–Window		0 1 2
	12. Child–Adult		0 1 2

§If the examinee provides a response that suggests he or she does not understand the task, provide the specified prompt in the Manual.

†If the examinee provides a 2-point response that requires feedback or provides an incorrect (0 point) response, provide corrective feedback as instructed in the Manual.

continue

4. Similarities *(continued)*

Discontinue after **3** consecutive scores of 0.

Verbal Items	Response	Score
13. Shoulder–Ankle		0 1 2
14. Love–Hate		0 1 2
15. Smooth–Rough		0 1 2
16. Hand–Flag		0 1 2
17. Wall–Line		0 1 2
18. Heat–Wind		0 1 2
19. More–Less		0 1 2
20. Shadow–Echo		0 1 2
21. Tradition–Habit		0 1 2
22. Peace–War		0 1 2
6–8 STOP 23. Time–Progress		0 1 2
24. Memory–Practice		0 1 2

Maximum Raw Score
Ages 6–8: 41
Ages 9–90: 45

Similarities Total Raw Score ____

WASI®-II

WECHSLER ABBREVIATED SCALE OF INTELLIGENCE®— SECOND EDITION

Examinee Name: _____ Age: _____

Parent/Guardian Name: _____

Examiner Name: _____

Record Form

Behavioral Observations

Referral source/Reason for referral/Presenting complaint(s)

Physical appearance

Language (e.g., first/native language, other language, English fluency, expressive and receptive language ability, articulation)

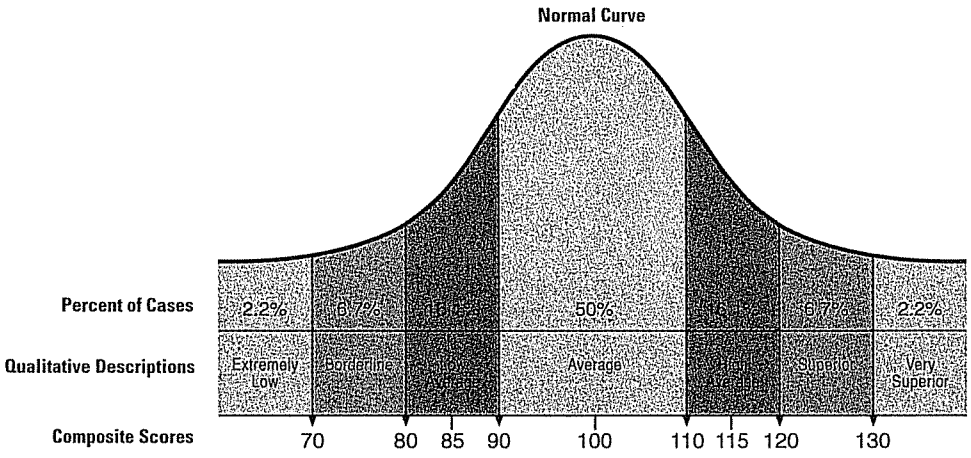
Attention and concentration

Attitude toward testing (e.g., rapport, eager to speak, working habits, interest, motivation, reaction to success/failure)

Affect/Mood

Unusual behaviors/Verbalizations (e.g., perseverations, stereotypic movements, bizarre and atypical verbalizations)

Other notes



PEARSON

Pearson Executive Office 5601 Green Valley Drive Bloomington, MN 55437

800.627.7271 www.PsychCorp.com

Subject: _____ Date: _____ Time: ____:____

SSS #1

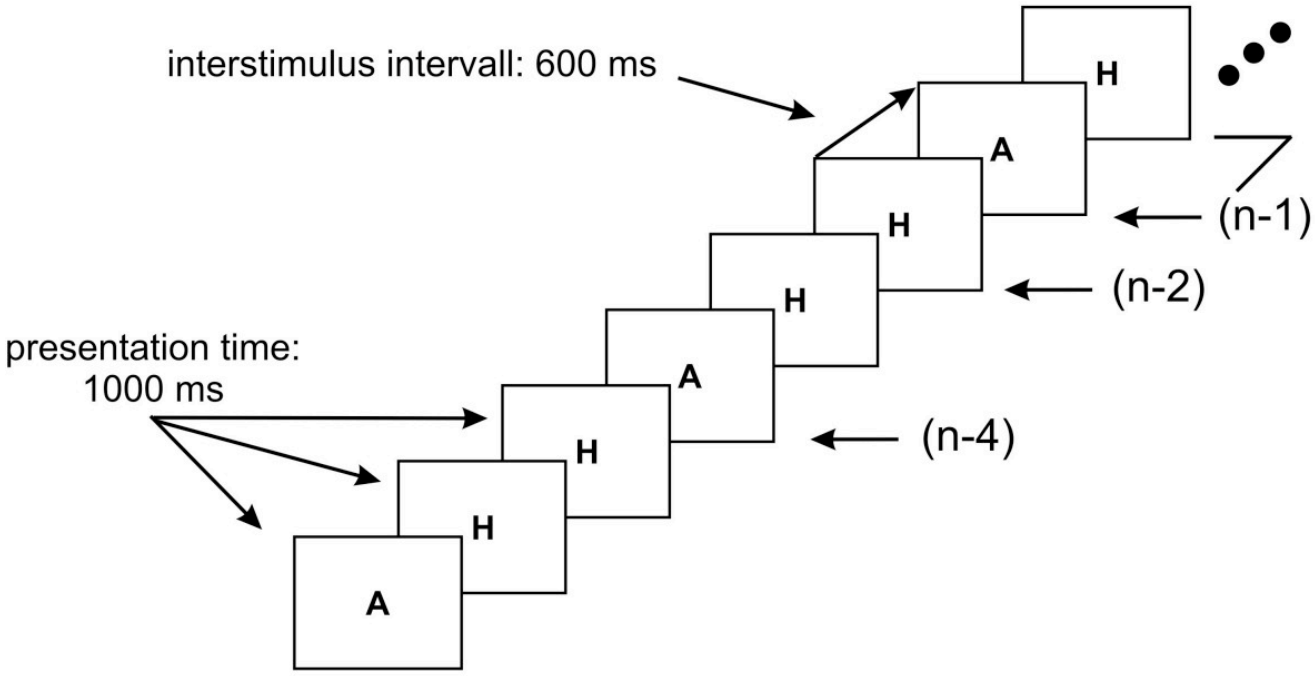
Please put an **X** next to the statement that best describes how you feel:

Right now I am:

- ☐ Feeling active, vital, alert or wide awake
- ☐ Functioning at high levels, but not at peak; able to concentrate
- ☐ Awake, but relaxed; responsive but not fully alert
- ☐ Somewhat foggy, let down
- ☐ Foggy; losing interest in remaining awake; slowed down
- ☐ Sleepy, woozy, fighting sleep; prefer to lie down
- ☐ No longer fighting sleep, sleep onset soon; having dream-like thoughts
- ❖ Asleep

Multi-Source Interference Task (MSIT)

N-back task


interstimulus intervall: 600 ms
presentation time:
1000 ms
H
A
H
H
A
H
A
(n-1)
(n-2)
(n-4)

RBANS™

Repeatable Battery for the Assessment of Neuropsychological Status

Christopher Randolph

Record Form A

Subject #_____ Age____ Sex____ Education Level _____

Examiner_____ Date of Testing_____ Ethnicity_____

Observations: _____

_____

_____

	Immediate Memory	Visuospatial/ Constructional	Language	Attention	Delayed Memory	Total Scale
Index Score						
Confidence Interval ____%						
Percentile						

Index Score	Percentile Rank	Total Scale Index Score
160	>99.9	160
155	>99.9	155
150	>99.9	150
145	99.9	145
140	99.6	140
135	99	135
130	98	130
125	95	125
120	91	120
115	84	115
110	75	110
105	63	105
100	50	100
95	37	95
90	25	90
85	16	85
80	9	80
75	5	75
70	2	70
65	1	65
60	0.4	60
55	0.1	55
50	<0.1	50
45	<0.1	45
40	<0.1	40

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1 List Learning

Trial 1

Say *I am going to read you a list of words. I want you to listen carefully and, when I finish, repeat back as many words as you can. You don't have to say them in the same order that I do—just repeat back as many words as you can remember, in any order. Okay?*

Trials 2–4

Say *I am going to read the list again. When I finish, repeat back as many words as you can, even if you have already said them before. Okay?*

Record responses in order.

Scoring: 1 point for each word correctly recalled on each trial.

List	Trial 1	Trial 2	Trial 3	Trial 4
Market				
Package				
Elbow				
Apple				
Story				
Carpet				
Bubble				
Highway				
Saddle				
Powder				

Number Correct		+		+		+		=	
	Total Trial 1		Total Trial 2		Total Trial 3		Total Trial 4		Total Score Range=0–40

2 Story Memory

Trial 1

Say ***I am going to read you a short story. I'd like you to listen carefully and, when I finish, repeat back as much of the story as you can remember. Try and use the same wording, if you can. Okay?***

Read the story below, then say ***Now repeat back as much of that story as you can.***

Trial 2

Say ***I am going to read that same story again. When I finish, I want you to again repeat back as much of the story as you can remember. Try to repeat it as exactly as you can.***

Read the story below, then say ***Now repeat back as much of that story as you can.***

Scoring: 1 point for *verbatim* recall of bold, italic words or alternatives, shown below in color within parentheses. Record intrusions or variations in the Responses column.

Story	Responses	Trial 1 Score (0 or 1)	Trial 2 Score (0 or 1)	Item Score (0–2)
1. On ***Tuesday,***				
2. ***May***				
3. ***Fourth,***				
4. in ***Cleveland,*** Ohio,				
5. a ***3 alarm***				
6. ***fire*** broke out.				
7. ***Two***				
8. ***hotels***				
9. and a ***restaurant***				
10. were ***destroyed***				
11. before the ***firefighters (firemen)***				
12. were able to ***extinguish it (put it out).***				
			Total Score (Trial 1 + Trial 2) Range=0–24	

3 Figure Copy

Time Limit: 4 minutes

Fold this page back and present the Figure Copy Drawing Page along with the stimulus. Ask the examinee to make an exact copy of the figure. Tell the examinee that he or she is being timed, but that the score is based *only* on the exactness of his or her copy.

Scoring: 1 point for correctness and completeness (drawing), and 1 point for proper placement. See Appendix 1 in Stimulus Booklet A for complete scoring criteria and scoring examples.

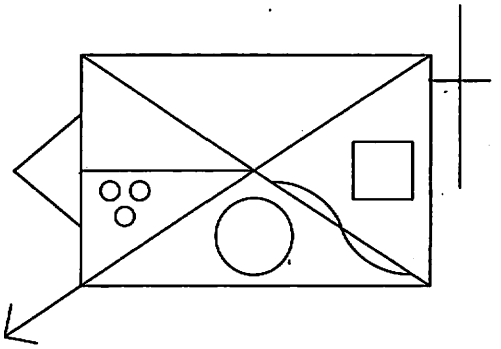

Figure Copy Criteria

(Fold back for use.)

Item	Drawing (0 or 1)	Placement (0 or 1)	Score (0, 1, or 2)	Scoring Criteria
1. rectangle				**Drawing:** lines are unbroken and straight; angles 90 degrees; top/bottom lines 25% longer than sides **Placement:** not rotated more than 15 degrees
2. diagonal cross				**Drawing:** lines are unbroken and straight and should approximately bisect each other **Placement:** ends of lines should meet corners of the rectangle without significant overlap or measurable distance between the ends of the lines and the corners
3. horizontal line				**Drawing:** line is unbroken and straight; should not exceed 1/2 the length of the rectangle **Placement:** should bisect left side of the rectangle at approximately a right angle and intersect the diagonal cross
4. circle				**Drawing:** round, unbroken and closed; diameter should be approximately 1/4–1/3 height of rectangle **Placement:** placed in appropriate segment; not touching any other part of figure
5. 3 small circles				**Drawing:** round, unbroken and closed; equal size; triangular arrangement; not touching each other **Placement:** in appropriate segment; not touching figure; triangle formed not rotated more than 15 degrees
6. square				**Drawing:** must be closed; 90 degree angles; lines straight and unbroken; height is 1/4–1/3 height of rectangle **Placement:** in appropriate segment; not touching any other part of figure; not rotated more than 15 degrees
7. curving line				**Drawing:** 2 curved segments are approximately equal in length and symmetrical; correct direction of curves **Placement:** ends of line touch diagonal; do not touch corner of rectangle or intersection of diagonal lines
8. outside cross				**Drawing:** vertical line of the outside cross is parallel to side of rectangle; >1/2 the height of rectangle; horizontal line crosses vertical at 90 degree angle and is between 20–50% of length of vertical line **Placement:** horizontal line of outside cross touches rectangle higher than 2/3 the height of rectangle, but below top; does not penetrate the rectangle
9. triangle				**Drawing:** angle formed by 2 sides of triangle is between 60–100 degrees; sides are straight, unbroken and meet in a point; distance on vertical side of rectangle subsumed by triangle is approximately 50% of the height of vertical side **Placement:** roughly centered on the left vertical side of the rectangle
10. arrow				**Drawing:** straight and unbroken; lines forming arrow are approximately equal in length and not more than 1/3 length of staff **Placement:** must protrude from appropriate corner of rectangle such that staff appears to be continuation of diagonal cross
		Total Score Range=0–20		

Figure Copy Drawing Page

(Fold back for use.)

4 Line Orientation

Time Limit: 20 seconds/item

Present the sample item, and say ***These two lines down here*** (indicate) ***match two of the lines on top. Can you tell me the numbers, or point to the lines that they match?*** Correct any errors and make sure the examinee understands the task. Continue with Items 1–10.

Scoring: 1 point for each line correctly identified.

Item	Responses	Correct Responses	Score (0, 1, or 2)
Sample		1, 7	
1.		10, 12	
2.		4, 11	
3.		6, 9	
4.		8, 13	
5.		2, 4	

Item	Responses	Correct Responses	Score (0, 1, or 2)
6.		1, 6	
7.		3, 10	
8.		5, 8	
9.		1, 3	
10.		11, 13	
		Total Score Range=0–20	

5 Picture Naming

Time Limit: 20 seconds/item

Ask the examinee to name each picture. Give the semantic cue only if the picture is obviously misperceived.

Scoring: 1 point for each item that is correctly named spontaneously or following semantic cue.

Item	Semantic Cue	Responses	Score (0 or 1)
1. chair	a piece of furniture		
2. pencil	used for writing		
3. well	you get water from it		
4. giraffe	an animal		
5. sailboat	used on the water (if "boat," query "what kind")		
6. cannon	a weapon, used in war		
7. pliers	a tool		
8. trumpet	a musical instrument ("cornet" okay)		
9. clothespin	used to hold laundry on a line		
10. kite	it's flown in the air		
		Total Score Range=0–10	

6 Semantic Fluency

Time Limit: 60 seconds

Say ***Now I'd like you to tell me the names of all of the different kinds of fruits and vegetables that you can think of. I'll give you one minute to come up with as many as you can. Ready?***

Scoring: 1 point for each correct response.

1. _____	11. _____	21. _____	31. _____
2. _____	12. _____	22. _____	32. _____
3. _____	13. _____	23. _____	33. _____
4. _____	14. _____	24. _____	34. _____
5. _____	15. _____	25. _____	35. _____
6. _____	16. _____	26. _____	36. _____
7. _____	17. _____	27. _____	37. _____
8. _____	18. _____	28. _____	38. _____
9. _____	19. _____	29. _____	39. _____
10. _____	20. _____	30. _____	40. _____

Total Score
Range=0–40 ☐

7 Digit Span

Say ***I am going to say some numbers, and I want you to repeat them after me. Okay?***
Read the numbers at the rate of 1 per second. Only read the second string in each set if the first string was failed. Discontinue after failure of both strings in any set.

Scoring: 2 points for the first string correct, 1 point for the second string correct, and 0 points for both strings failed.

Item First String	String Score (0 or 2)	Second String	String Score (0 or 1)	Item Score (0–2)
1. 4—9		5—3		
2. 8—3—5		2—4—1		
3. 7—2—4—6		1—6—3—8		
4. 5—3—9—2—4		3—8—4—9—1		
5. 6—4—2—9—3—5		9—1—5—3—7—6		
6. 2—8—5—1—9—3—7		5—3—1—7—4—9—2		
7. 8—3—7—9—5—2—4—1		9—5—1—4—2—7—3—8		
8. 1—5—9—2—3—8—7—4—6		5—1—9—7—6—2—3—6—5		

Total Score
Range=0–16 ☐

8 Coding

Time Limit: 90 seconds

Say ***Look at these boxes*** (indicate key). ***For each one of these marks there is a number that goes with it. Down here there are marks, but no numbers. I want you to fill in the number that goes with each mark.***

Demonstrate the first three. Say ***Now I would like you to fill in the rest of these boxes up to the double lines*** (indicate) ***for practice.*** Correct any errors as they are made. Make sure that the examinee understands the task and has correctly completed the sample items before you begin timing.

Say ***Now I would like you to continue to fill in the numbers that match the marks. Go as quickly as you can without skipping any. When you reach the end of the line, go on to the next one. Ready? Go ahead.***

Redirect the examinee to the task if he or she becomes distracted. If the examinee is unable to comprehend the task, the subtest score is 0.

Scoring: 1 point for each item correctly coded within 90 seconds (*do not* score the sample items).

Note: Familiarize yourself with these instructions before administering this subtest.

Total Score Range=0–89	

9 List Recall

Say ***Do you remember the list of words that I read to you in the beginning? Tell me as many of those words as you can remember now.***

Scoring: 1 point for each word correctly recalled.

List (Do not read.)	Response	Score (0 or 1)
Market		
Package		
Elbow		
Apple		
Story		
Carpet		
Bubble		
Highway		
Saddle		
Powder		
	Total Score Range=0–10	

10 List Recognition

Say ***I'm going to read you some words. Some of these words were on that list, and some of them weren't. I want you to tell me which words were on the list.*** For each word, ask ***Was_____ on the list?***

Scoring: 1 point for each word correctly identified. Circle the letter corresponding to examinee's response (y = yes, n = no); bold, capitalized (**Y, N**) letter indicates correct response.

List	Circle One	List	Circle One	List	Circle One	List	Circle One
1. **Apple**	**Y** n	6. sailor	y **N**	11. **Bubble**	**Y** n	16. **Saddle**	**Y** n
2. honey	y **N**	7. velvet	y **N**	12. prairie	y **N**	17. **Powder**	**Y** n
3. **Market**	**Y** n	8. **Carpet**	**Y** n	13. **Highway**	**Y** n	18. angel	y **N**
4. **Story**	**Y** n	9. valley	y **N**	14. oyster	y **N**	19. **Package**	**Y** n
5. fabric	y **N**	10. **Elbow**	**Y** n	15. student	y **N**	20. meadow	y **N**
						Total Score Range=0–20	

11 Story Recall

Say: ***Do you remember that story about a fire that I read to you earlier? Tell me as many details from the story as you can remember now.***

Scoring: 1 point for each verbatim recall of bold, italic words or alternatives, shown below in color within parentheses. Record intrusions or variations in the Responses column.

Story (Do not read.)	Responses	Item Score (0 or 1)
1. On ***Tuesday,***		
2. ***May***		
3. ***Fourth,***		
4. in ***Cleveland,*** Ohio,		
5. a ***3 alarm***		
6. ***fire*** broke out.		
7. ***Two***		
8. ***hotels***		
9. and a ***restaurant***		
10. were ***destroyed***		
11. before the ***firefighters (firemen)***		
12. were able to ***extinguish it (put it out).***		
	Total Score Range=0–12	

12 Figure Recall

Say ***Do you remember that figure that I had you copy? I want you to draw as much of it as you can remember now. If you remember a part, but you're not sure where it goes, put it anywhere. Try to draw as much of it as you can.***

Now, present the Figure Recall Drawing Page.

Scoring: 1 point for correctness and completeness (drawing), and 1 point for proper placement. See Appendix 1 in Stimulus Booklet.A for complete scoring criteria and scoring examples.

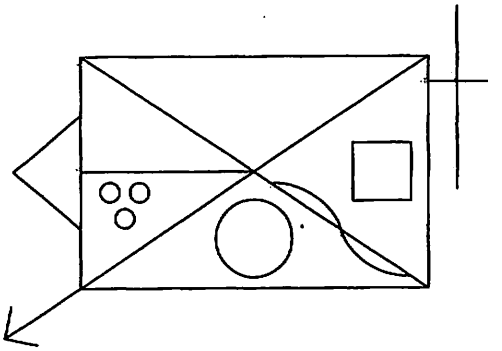

Figure Recall Criteria

(Fold back for use.)

Item	Drawing (0 or 1)	Placement (0 or 1)	Score (0, 1, or 2)	Scoring Criteria
1. rectangle				**Drawing:** lines are unbroken and straight; angles 90 degrees; top/bottom lines 25% longer than sides **Placement:** not rotated more than 15 degrees
2. diagonal cross				**Drawing:** lines are unbroken and straight and should approximately bisect each other **Placement:** ends of lines should meet corners of the rectangle without significant overlap or measurable distance between the ends of the lines and the corners
3. horizontal line				**Drawing:** line is unbroken and straight; should not exceed 1/2 the length of the rectangle **Placement:** should bisect left side of the rectangle at approximately a right angle and intersect the diagonal cross
4. circle				**Drawing:** round, unbroken and closed; diameter should be approximately 1/4–1/3 height of rectangle **Placement:** placed in appropriate segment; not touching any other part of figure
5. 3 small circles				**Drawing:** round, unbroken and closed; equal size; triangular arrangement; not touching each other **Placement:** in appropriate segment; not touching figure; triangle formed not rotated more than 15 degrees
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7. curving line				**Drawing:** 2 curved segments are approximately equal in length and symmetrical; correct direction of curves **Placement:** ends of line touch diagonal; do not touch corner of rectangle or intersection of diagonal lines
8. outside cross				**Drawing:** vertical line of the outside cross is parallel to side of rectangle; >1/2 the height of rectangle; horizontal line crosses vertical at 90 degree angle and is between 20–50% of length of vertical line **Placement:** horizontal line of outside cross touches rectangle higher than 2/3 the height of rectangle, but below top; does not penetrate the rectangle
9. triangle				**Drawing:** angle formed by 2 sides of triangle is between 60–100 degrees; sides are straight, unbroken and meet in a point; distance on vertical side of rectangle subsumed by triangle is approximately 50% of the height of vertical side **Placement:** roughly centered on the left vertical side of the rectangle
10. arrow				**Drawing:** straight and unbroken; lines forming arrow are approximately equal in length and not more than 1/3 length of staff **Placement:** must protrude from appropriate corner of rectangle such that staff appears to be continuation of diagonal cross
		Total Score Range=0–20		

Figure Recall Drawing Page

(Fold back for use.)

ANAM4™

Automated Neuropsychological Assessment Metrics

Quick Start Guide

Scope of This Document

This is a quick start reference to familiarize a first-time user with the basic concepts and operations of the ANAM4™ software.

Disclaimer

The ANAM4™ testing system does not constitute the practice of medicine or the provision of professional health care advice. The information provided by ANAM4™ software is of a general nature and does not represent medical advice, a diagnosis, or prescription for treatment. You are advised to seek the advice of a qualified medical professional or researcher for interpretation of test results. C-SHOP and the University of Oklahoma are not responsible for any decisions made based on information obtained using ANAM4™ software. Your qualified medical professional has the sole responsibility for establishing diagnosis and suggesting appropriate treatment.

Further Reading

For additional information regarding ANAM4™ or ANAM4™ data files, please refer to the ANAM4™ User Guide.

Revision 3, March 2007

Table of Contents

Requirements

Hardware Requirements

The ANAM4™ system is designed for use on personal computer systems. Minimum hardware requirements include the following:

- **Processor speed:** Pentium 90 MHz microprocessor.
- **Memory:** 32 MB RAM.
- **Storage:** The core ANAM4™ test system requires a minimum of approximately 25MB. Due to data storage requirements and to ensure optimal performance, at least 150MB of free space is highly recommended. A full ANAM4™ installation including ancillary modules (ADEPT™/APR™) requires approximately 50MB of space (130MB if the .NET Framework v2.0 is not already present). Due to data storage requirements and to ensure optimal performance, at least 300MB of free space prior to installation is highly recommended.
- **Response device:** Most standard input devices are supported, including a serial mouse, USB mouse and keyboard, and PS/2 mouse and keyboard. When using laptop computers, most internal keyboards and pointing devices will be adequate for most ANAM4 test modules, but the use of external input devices is highly recommended where practical.

Software Requirements

- **Operating system:** Windows 95/98/2000, NT4.0, or XP. To date, ANAM4™ has not been fully tested on Windows ME or Windows Vista.
- **Windows updates:** Application of all Windows updates. Updates are available at: http://update.microsoft.com
- **Flash animation:** For operating systems older than Windows XP, Adobe Flash Player is required to view the opening logo screen. Flash may be acquired via free download: http://www.adobe.com/go/getflashplayer

  Note: When installing Flash Player via the website, uncheck the accompanying Yahoo toolbar before clicking "Install Now" unless you desire the toolbar.

1 Installing and Running ANAM4™

The ANAM4™ test system consists of a library of tests designed for a broad spectrum of clinical and research applications. This library of computer-based tests was constructed to meet the need for precise measurement of cognitive processing efficiency in a variety of psychological assessment contexts that include neuropsychology, readiness to perform, neurotoxicology, pharmacology, and human factors research.

ANAM4™ will be automatically installed from the installation CD. If the installation does not begin automatically, click Start > Run on the task bar. Type your CD drive letter followed by :\Setup (e.g., D:\Setup or E:\Setup). Finally, click **OK** to proceed with the installation.

The default installation directory is C:\Program Files\C-SHOP\ANAM4.

Upon installation, a desktop icon for ANAM4™ will be created. 

To run ANAM4™, double-click on the ANAM4™ icon located on your desktop, the AnamMenu.exe file located in the C:\Program Files\C-SHOP\ANAM4 directory, or the ANAM4 program listed in start->Programs->ANAM4.

2 Starting ANAM4™

Starting ANAM4™

1. Double-click the ANAM4 icon on your desktop.

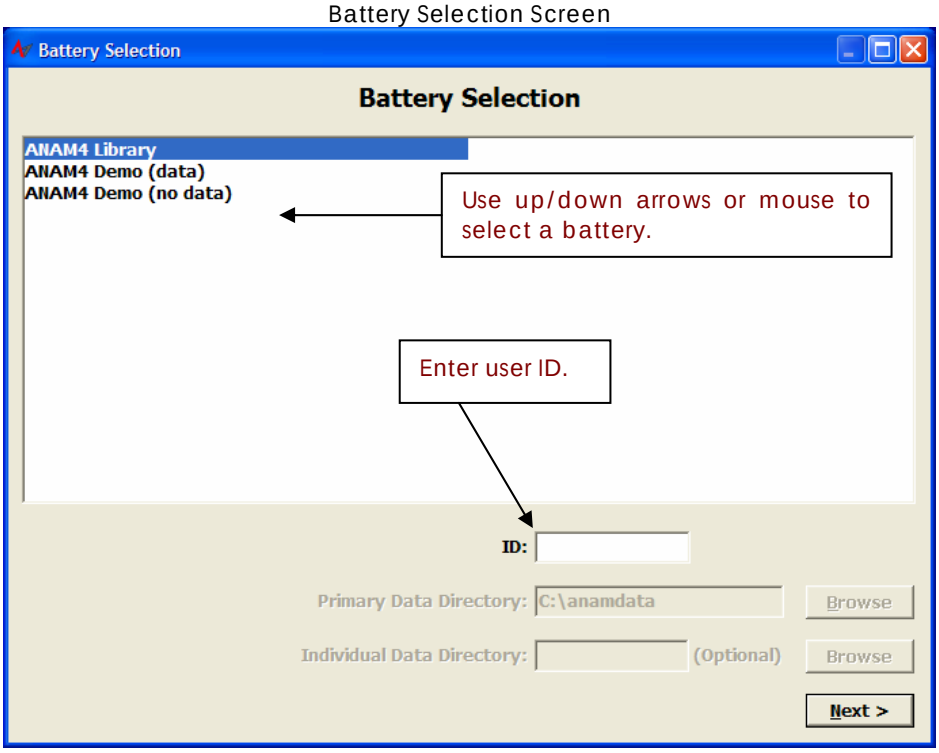
ANAM4 Splash Screen

Selecting a Battery and Entering the User ID

The *Battery Selection* screen allows the user to choose a battery, specify an ID number, and specify data directories.

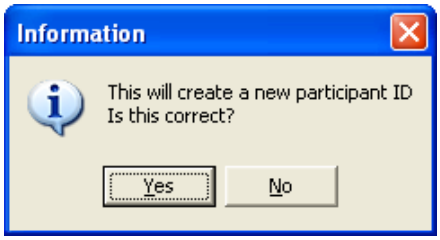
1. Use the up/down cursor keys or mouse to select the desired ANAM4™ battery.

Battery Selection Screen



2. Enter a user ID. The user ID can be any alphanumeric character string.

Note: If a test ID is entered that has never been used on this computer, you will be asked to verify that you are creating a new participant ID. If this is correct, click **Yes**. If the session is a repeat administration for this person (thus, the participant ID has been used previously), you will not receive this prompt.



Changing Data Directories (Folders)

The default data storage directory is C:\anamdata. All data files will be stored in this directory unless specified otherwise.

To change the Primary Data Directory or Individual Data Directory:

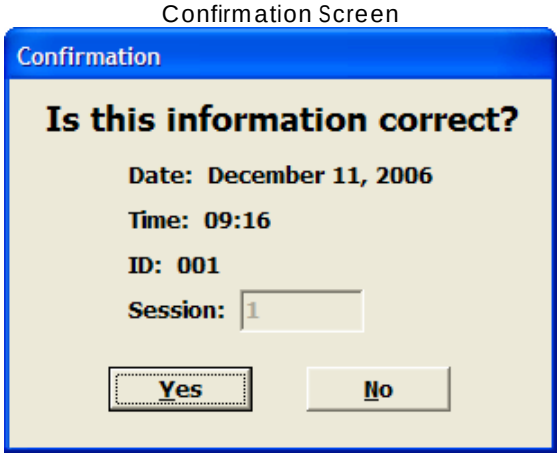
1. Press <**Alt**><**F1**>. This will unlock the *Primary Data Directory* and *Individual Data Directory* fields for modification.
2. Type the path location of the directory for data storage or click **Browse**. If you select Browse, navigate to the directory where you would like to store the ANAM data files.

After confirming all information on the *Battery Selection* screen, Press **Enter** or click **Next** to continue.

Confirming Date, Time, ID, and Session Number

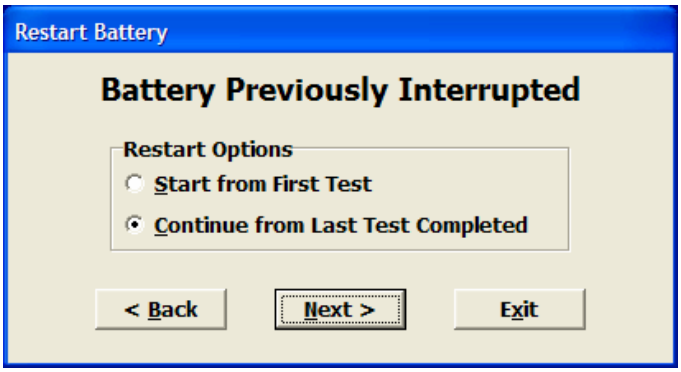
1. Confirm that the Date and Time on your computer are accurately set. If not, click on **No**, close the *Battery Selection* screen that reappears by clicking on the red close button at the upper right corner, correct the Date/Time setting, and restart ANAM4™.
2. Confirm that the correct Session number is about to be run. If you are certain that it needs to be changed, press <**Alt**><**F1**> to unlock the field and enter the desired session number.

Confirmation Screen



Restarting a Previously Cancelled Battery

1. If the specified Session was previously canceled before completion, you may see the following screen asking if you wish to *Start from First Test* or *Continue from Last Test Completed*. You are also allowed to go back to the *Battery Selection* screen.

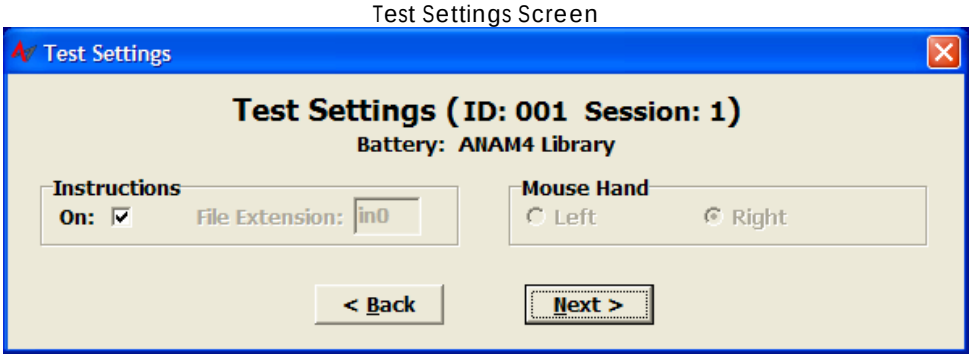


2. Once you have selected the desired option, click on **Next** to continue.

Selecting Test Settings

The *Test Settings* screen allows the user to customize the ANAM4™ test session.

Test Settings Screen



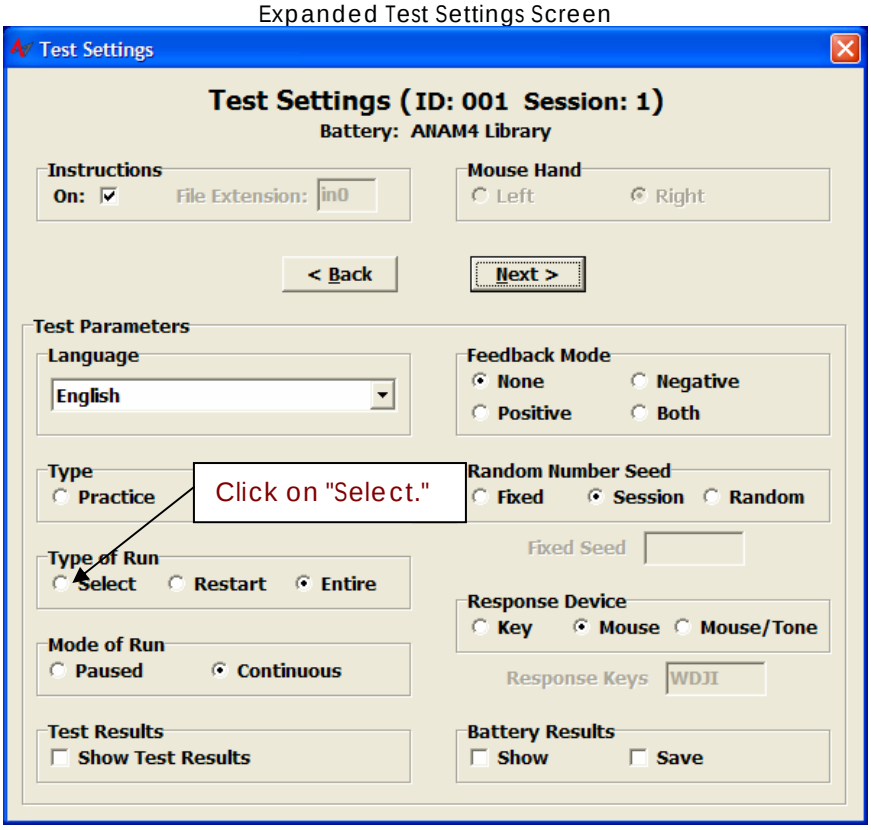
Note: After using the battery a few times for a particular person, you may wish to turn off instructions by deselecting the "Instructions" box. Make sure it is checked **On** the first time through.

1. If you have a participant who uses the computer mouse with the left hand and you wish to obtain responses using the left hand, press <**Alt**><**F1**> to unlock the Mouse Hand setting and select **Left**.
2. If the Test Settings are correct, press **Enter** or click on **Next** to begin the testing.

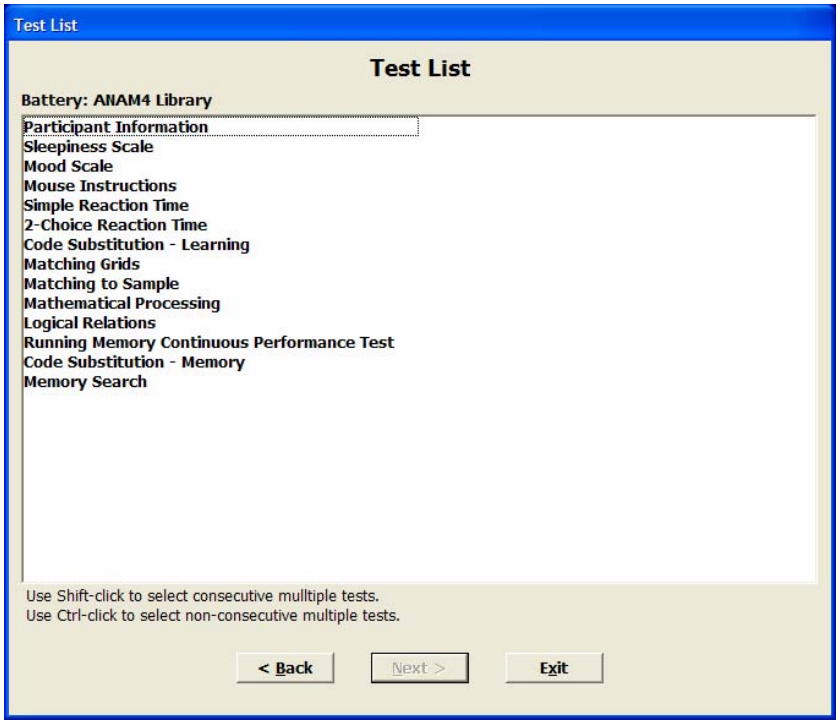
Selecting a Specific Test or Subset of Tests

1. If you wish to select a single test or subset of tests, press <**Alt**><**F2**> and then click on **Select** under Type of Run.

Expanded Test Settings Screen



2. Press **Enter** or click on **Next** to continue. The list of tests within the battery will appear on the next screen.



3. After selecting the desired test or set of tests using the instructions at the bottom of the screen, press **Enter** or click on **Next** to continue.

Proceeding through the Battery

1. Tests will proceed in sequence.

   Note: If instructions are On, the typical sequence for each test is one or more pages of instructions, a screen with the test name, the test itself, and (if selected from the *Test Settings* screen) a feedback screen summarizing individual Test Results.

2. If you wish to abort from any test (end the test without collecting data), press <**Alt**><**F1**> at any time following the instructions screen(s).

   Note: The <**Alt**><**F1**> exit function works ONLY after the display of test instructions is complete.

3. After the test aborts, you will see the above window. If you wish to cancel the rest of the battery, click **Yes**. If you wish to continue with the remaining tests, click **No**.
4. At the conclusion of the battery, you will see a "Thank You" message informing you that the Test Battery is complete.

ANAM4™ Data

Four types of data files are generated following test administration through the ANAM4™ test system as follows:

- Summary Data Files in Text Format (CSV) – summary statistics computed across all items/trials of a given test (without variable labels)
- Raw Data Files in Text Format (CSV) – individual item/trial information (without variable labels)
- Summary Data Files in XML Format – summary statistics computed across all items/trials of a given test (with variable labels)
- Raw Data Files in XML Format – Individual item/trial information (with variable labels).

File Naming

Data filenames are coded in the following manner. The first letter represents the type of file as follows:

- **S** for summary data in text format
- **R** for raw data in text format
- **X** for summary data in XML format
- **Z** for raw data in XML format.

The next sequence of characters corresponds to the participant ID code (of variable length). The ID code is followed by a P or T designating a Practice or Test session, respectively. The final portion of the filename indicates the session number. A three-letter file extension is used to identify the specific test. A list of test extensions can be found in **Chapter 4**.

> Example: ***S32545T01.SRT*** is a summary data file for participant 32545 for Test Session number 1 of the Simple Reaction Time test.

ANAM4™ Data Directories

The default *Primary Data Directory* is C:\anamdata. Data from all completed tests will be saved in this directory. By default, no *Individual Data Directory* is specified. For information on changing the *Primary Data Directory* or *Individual Data Directory*, see **Chapter 2**.

ANAM4™ Tests

ANAM4™ Test Names, Modules, and Extensions

Test Name	Module Name (.exe)	Extension
2-Choice Reaction Time	2choice	.2ch
4-Choice Reaction Time	4choice	.4ch
Code Substitution		
Learning	codesub	.cds
Immediate	codesub	.cdi
Delayed	codesub	.cdd
Demographics	demog	.sub
Digit Reaction Time	digitrt	.drt
Dual Task (Tracking / Memory)	dualtask	.dtn
Grammatical Reasoning	gram	.grm
Logical Relations	logical	.lrs
Manikin	manikin	.mkn
Matching Grids	matching	.mtg
Matching to Sample	mat2samp	.m2s
Mathematical Processing	math	.mth
Memory Search	stern	.stn
Mental State Exam	mse	.mse
Mood Scale	mood	.moo
Procedural Reaction Time	procrt	.pro
Pursuit Tracking	pursuit	.pur
Reaction Time	react	.rct
Relative Judgment	reljudg	.rlj
Running Memory CPT	runcpt	.cpt
Simple Reaction Time	simplert	.srt
Sleepiness Scale	sleepsc	.slp
Spatial Processing - Simultaneous	dspat	.spd
Spatial Processing - Delayed	spat	.spa
Standard CPT	stdcpt	.scp
Stroop Test	stroop	.str
Switching	switch	.swt
Symbolic Reaction Time	symbolrt	.sym
Tapping	tapping	.tpl, .tpr
Tower Puzzle	tower	.atp
Unstable Tracking	track	.trk
Visual Vigilance	visvig	.vis

For More Information

ANAM4™ User Manual
www.c-shop.ou.edu/literature/manual.pdf

Quick Start Guide for the ADEPT™ Software
www.c-shop.ou.edu/literature/ADEPTquickstart.pdf

Quick Start Guide for the APR™ Software
www.c-shop.ou.edu/literature/APRquickstart.pdf

ANAM4™ Technical Literature
www.c-shop.ou.edu

Technical Support
www.c-shop.ou.edu

Center for the Study of Human Operator Performance
University of Oklahoma
3200 Marshall Ave, Suite 260
Norman OK 73072 USA
www.c-shop.ou.edu

Psychomotor Vigilance Test

Press the spacebar every time an “x” appears on the screen.

Subject: _____ Date:_____

Read the following scenarios. Each scenario presents a situation and asks a question about the chance or likelihood that you would experience a particular outcome. For each one, think about how likely that outcome would be for YOU in that situation. Do NOT worry about how most people would do in a particular situation—just think about the chance that a particular outcome would happen to YOU in that situation. Circle the percent chance that best represents the probability that the outcome would happen to YOU.

1. You arrive 25 minutes late for a big job interview. What is the probability that YOU will get the job?

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

2. If you were to find yourself confronted by a vicious angry dog, what is the probability that YOU could get away unharmed?

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

3. Regardless of your moral convictions, if you were to shoplift a pair of $50 sunglasses from a chain drug store, what is the probability that YOU could get away with it without being caught?

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4. While leaving a popular night club, you are attacked by a drunk man in his early 20s wielding a 10 inch knife. During the scuffle, your friend is stabbed, but not fatally. What is the chance that YOU will be killed during the attack?

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

5. While on vacation, you meet up with a stranger asking for help. Although the story the stranger tells you is heart wrenching and he seems very sincere, you are aware that he may just be a con-artist trying to scam you. If the stranger truly is a con-artist, what is the probability YOU will end up being scammed out of some of your money?

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

6. You awaken one morning realizing that you engaged in unprotected sex with someone you just met. Now that the alcohol has worn off, your partner remorsefully tells you that he/she has suffered for a long time with a very serious sexually transmitted disease. What is the chance that YOU will contract the sexually transmitted disease yourself after this contact?

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

7. While on vacation in a far away country, your 3 traveling companions have all contracted a bad case of diarrhea after drinking the water. You realize that you just drank some of the same water about an hour ago. What is the likelihood that YOU will come down with diarrhea too?

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

8. While on vacation in the woods, you decide to go hiking in an unfamiliar and thickly wooded area without a map or guide. What is the likelihood that YOU will get lost?

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

9. You have been at a nightclub for 4 hours. During that time you have had 7 alcoholic beverages. You are feeling a little "buzzed" but you decide to drive yourself home anyway because it is only about 5 miles away. What is the probability that YOU will make it home without any negative incident?

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

10. While playing golf one afternoon a thunderstorm comes up quickly. There is much wind and occasional lightning is hitting nearby. Because you are winning the game and only have two more holes to play, you decide to continue to the end. What is the likelihood that YOU will be struck by lightning before finishing the game?

    0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

11. While at your job you discover that one of your superiors has been embezzling large amounts of money from your organization. You decide to inform higher management of his illegal behavior. What is the chance that YOUR future career at the company will be harmed by reporting him?

    0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

12. Your company has a strict policy forbidding the removal of computer equipment from the work premises. However, you have a big project due that can only be completed if you "borrow" a company laptop computer over the weekend. What is the probability that YOU could secretly remove the computer for the weekend and return it to work on Monday without ever being caught?

    0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

13. You are a foreigner living in a war-torn country that is filled with violence and frequent sniper attacks. Although it is dark outside and there are many hostile insurgents in the area, you decide to drive alone and unarmed down a 10 mile stretch of empty highway to spend the weekend in the next town. What is the probability that YOU will be killed while making the trip?

    0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

14. While staying at a high rise hotel a bad fire breaks out several floors below yours. After hearing the fire alarm and smelling smoke, you quickly devise a plan of escape. What is the likelihood that YOU would be unable to figure out a way to escape and would die in the fire?

    0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

15. A severe natural disaster has devastated your town, resulting in widespread panic, looting, and deadly violence. The escape routes leading from the town are blocked with gridlock traffic and street gangs are killing at random and using violent means to steal limited necessities and survive. What is the chance that YOU will be able to outmaneuver the looters and escape the town unharmed?

    0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

16. You enter a competition in an arena in which you are particularly talented. What is the chance that YOU will ultimately win the competition?

    0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

17. You are sightseeing off a tall bridge where many individuals have tried to commit suicide by jumping to their deaths in the water below. Approximately half of all jumpers have not survived the long drop into the bay. Unfortunately, you stumble and are accidentally knocked off of the bridge. What is the likelihood that YOU would die in the fall?

    0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

18. Your biggest rival has challenged you in some way. What is the likelihood that YOU will ultimately defeat your rival at whatever he/she has challenged you with?

    0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

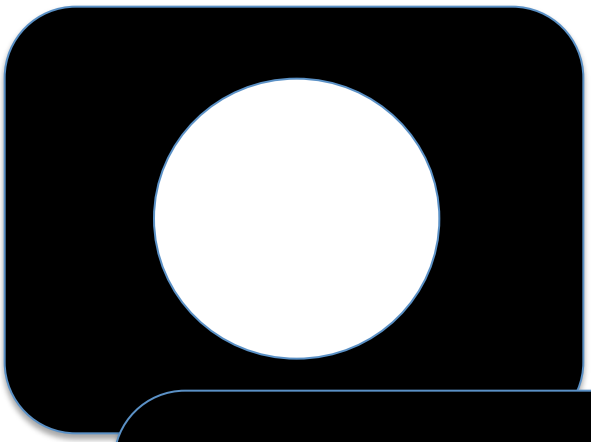
19. A bad automobile accident has just occurred in front of you. In one of the cars, the driver is unconscious and bleeding. You smell gas and notice that smoke is starting to billow out from the car. Afraid that the car may explode at any moment, you work to pull the unconscious driver from the car. What is the chance that YOU will die in the process of saving the driver?

    0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

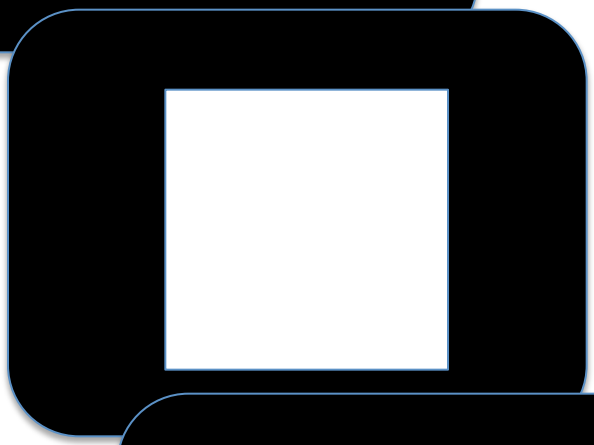
20. While on vacation on a tropical island you decided to rent a small motor boat to do some sightseeing and fishing out along the island coast. After stopping the boat some distance from the shore you lay down to take a brief nap. Upon awakening you realize that you can no longer see the shore and notice that there is a fierce storm coming. What is the likelihood that YOU will die at sea?

    0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

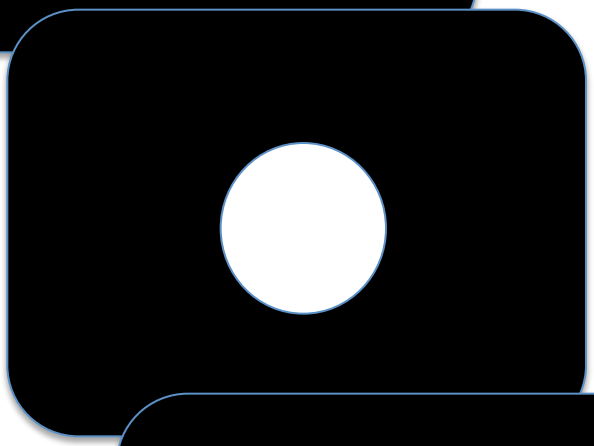
Go/No-Go Task



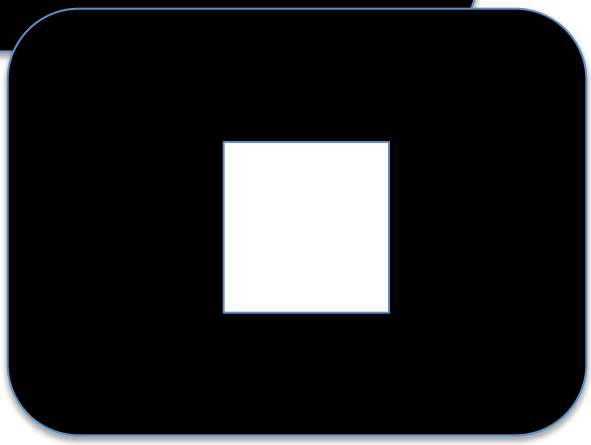
Go



Go



Go



No Go

Day of Scan Information Questionnaire (DSIQ)

Day of Scan Information Questionnaire (DSIQ)

Subject ID _____

Date _____

Age _____
(Years)

Height _____
(Feet/Inches)

Weight _____
(Pounds)

Sex

◯ Male
◯ Female

Handedness

◯ Right
◯ Left
◯ Both/Neither

What is the highest grade or level of school that you have completed or the highest degree you have obtained?

◯ < 9th
◯ 9th
◯ 10th
◯ 11th
◯ HS Grad
◯ 2yr College
◯ College Grad
◯ Some Grad School
◯ Masters
◯ Doctorate

With what ethnicity do you identify?

◯ White
◯ Hispanic/Latino
◯ Black/African-American
◯ Native-American/American Indian
◯ Asian/Pacific Islander
◯ Other

Do you have any problems with reading?

◯ No ◯ Yes

If yes, please explain

_____

What is your primary language (what do you speak at home most of the time)?

◯ English ◯ Spanish ◯ Other

If other, please specify

_____

Caffeine Use

Did you have any caffeine containing products today?

◯ Yes ◯ No

If yes, how much?

_____

On average, how many cups of caffeinated coffee do you drink per day?

_____

On average, how many cups of caffeinated tea do you drink per day?

_____

On average, how many cans of caffeinated soda do you drink per day?

_____

On average, how many caffeinated sports drinks do you drink per day?

_____

If you drink caffeinated sports drinks, what brand do you drink?

_____

Do you use any other caffeinated products, such as Vivarin?

◯ Yes ◯ No

If yes, what?

_____

How much?

_____

How often?

_____

Nicotine Use

Do you smoke cigarettes?

◯ Yes ◯ No

If YES, about how many cigarettes do you smoke per day?

_____

How long have you been smoking?

_____
(____ years ____ months)

Have you tried to quit?

◯ Yes ◯ No

If YES, how many times?

_____

If NO, did you ever smoke cigarettes in the past?

◯ Yes ◯ No

If YES, how many cigarettes did you smoke per day?

_____

When did you start smoking? _____

When did you quit? _____

Do you use smokeless tobacco, such as dip or chew?

◯ Yes ◯ No

If YES, about how much do you use per day?

_____

If NO, did you ever use smokeless tobacco in the past?

◯ Yes ◯ No

If YES, how much did you use per day?

_____

When did you start using? _____

When did you quit? _____

Do you use any other nicotine-containing products?

◯ Yes ◯ No

If YES, what?

_____

How much?

_____

How often?

_____

Other

Do you take diet pills?

◯ Yes ◯ No

If YES, what brand?

_____

How much?

_____

How often?

_____

Are you currently taking any medications, vitamins, or supplements?

◯ Yes ◯ No

If YES, please list:

_____
(Name: ____ Dosage (per day): ____ (e.g. Ibuprofen, 200 mg))

If YES, please list:

_____
(Name: ____ Dosage (per day): ____)

If YES, please list:

_____
(Name: ____ Dosage (per day): ____)

If YES, please list:

_____
(Name: ____ Dosage (per day): ____)

How many times per month do you drink (alcohol)?

_____

On those occasions, what is the average number of drinks you consume?

_____

On those occasions, what is the largest number of drinks you consume?

_____

How many times in the past year have you used marijuana?

_____

Have you ever used marijuana at other times in your life?

◯ Yes ◯ No

If YES, at what age did you begin smoking marijuana?

_____

On approximately how many occasions have you used marijuana?

_____

Do you use any other street drugs currently or in the past year?

◯ Yes ◯ No

If yes, what?

_____

How much?

_____

How often?

_____

Physical Information

If female, when was your last menstrual period (be as precise as possible)?

_____

(Date of period: _____ or about _____ days ago)

Concussion Information

How many "concussions" have you had in your life?

_____

Did you lose consciousness or get "knocked out" each time?

_____

How long ago was your most recent concussion?

_____

Date it happened _____

Briefly describe the situation that led to your most recent concussion

_____

Did you "see stars" during your last concussion?

◯ Yes ◯ No

Did you lose consciousness during your last concussion?

◯ Yes ◯ No

If YES, for how long were you unconscious?

_____
(Minutes)

Did you notice that your sleep became worse following the concussion?

◯ Yes ◯ No

After your concussion, what sleep problems became more noticeable to you (Select all that apply)?

	Yes	No
I get sleepier during the day	◯	◯
I get drowsier than I used to when trying to concentrate or work	◯	◯
I fall asleep when I should not	◯	◯
It is harder to stay alert during the day	◯	◯
It is harder to fall asleep at night	◯	◯
I fall asleep much later than I used to	◯	◯
I fall asleep much earlier than I used to	◯	◯
I sleep later in the morning than I used to	◯	◯
I wake up much earlier in the morning than I used to	◯	◯
When I do sleep, it is fitful or less restful than it used to be	◯	◯
I wake up off and on throughout the night more than I used to	◯	◯
I have more nightmares than I used to	◯	◯

In the months BEFORE your concussion, at what time did you normally go to bed at night on weeknights (Sun-Thurs)?

_____
(In standard time HH:MM)

AM or PM?

◯ AM ◯ PM

In the months BEFORE your concussion, at what time did you normally go to bed at night on weekends (Fri-Sat)?

_____
(In standard time HH:MM)

AM or PM?

◯ AM ◯ PM

In the months BEFORE your concussion, what time did you typically awaken on weekdays (Mon-Fri)?

_____
(In standard time HH:MM)

AM or PM?

◯ AM
◯ PM

In the months BEFORE your concussion, what time did you typically awaken on weekends (Sat-Sun)?

_____
(In standard time HH:MM)

AM or PM?

◯ AM ◯ PM

In the months BEFORE your concussion, how long did it typically take you to fall asleep at night on weeknights (Sun-Thurs)?

_____
(HH:MM)

In the months BEFORE your concussion, how long did it typically take you to fall asleep at night on weekends (Fri-Sat)?

_____
(HH:MM)

Current Sleep Habits

How much sleep did you get last night?

_____
(HH:MM (e.g. 07:30 for 7 hours 30 minutes of sleep))

Since your concussion, how much do you typically sleep on weeknights (Sun-Thurs)?

_____
(HH:MM)

Since your concussion, how much do you typically sleep on weekend nights (Fri-Sat)?

_____
(HH:MM)

Since your concussion, at what time do you normally go to bed at night on weeknights (Sun-Thurs)?

_____
(In standard time HH:MM)

AM or PM?

◯ AM
◯ PM

Since your concussion, at what time do you normally go to bed at night on weekends (Fri-Sat)?

_____
(In standard time HH:MM)

AM or PM?

◯ AM
◯ PM

Since your concussion, at what time do you typically awaken on weekdays (Mon-Fri)?

_____
(In standard time HH:MM)

AM or PM?

◯ AM
◯ PM

Since your concussion, at what time do you typically awaken on weekends (Sat-Sun)?

_____
(In standard time HH:MM)

AM or PM?

◯ AM
◯ PM

Since your concussion, how long does it typically take to fall asleep at night on weeknights (Sun-Thurs)?

_____
(HH:MM (e.g. 00:15 for 15 minutes))

Since your concussion, how long does it typically take you to fall asleep at night on weekends (Fri-Sat)?

_____
(HH:MM)

Since your concussion, at what time of day do you feel sleepiest?

_____
(In standard time HH:MM)

AM or PM?

◯ AM
◯ PM

Since your concussion, at what time of day do you feel most alert?

_____
(In standard time HH:MM)

AM or PM?

◯ AM ◯ PM

Since your concussion, how much time do you need to sleep per night to feel your best?

_____
(HH:MM)

Since your concussion: "If I get less than _____ hours/minutes of sleep, I notice an impairment in my ability to function at work."

_____
(HH:MM)

Since your concussion: "If I get more than _____ hours/minutes of sleep, I notice an impairment in my ability to function at work."

_____
(HH:MM)

Is daytime sleepiness currently a problem for you?

◯ Yes ◯ No

Are you currently doing shift work, that is, working early morning, evening, or night shifts?

◯ Yes ◯ No

Do you ever have trouble falling asleep?

◯ Yes ◯ No

If yes, how often per week, month, or year?

_____
((Designate time period in the next question))

If yes, how often per time period?

◯ Week
◯ Month
◯ Year

If yes, did this start or get worse since your concussion?

◯ Yes ◯ No

Do you ever have trouble staying asleep?

◯ Yes ◯ No

If yes, how often per week, month, or year?

_____
((Designate time period in the next question))

If yes, how often per time period?

◯ Week
◯ Month
◯ Year

If yes, did this start or get worse since your concussion?

◯ Yes ◯ No

Do you take more than two daytime naps per month?

◯ Yes ◯ No

If yes, about how many times per week do you nap?

_____

At what time of day do you normally begin your nap?

_____
(HH:MM)

AM or PM?

◯ AM
◯ PM

At what time of day do you normally wake up from your nap?

_____
(HH:MM)

AM or PM?

◯ AM
◯ PM

Do you consider yourself a light, normal, or heavy sleeper?

◯ Light
◯ Normal
◯ Heavy

Have you ever been diagnosed or treated for sleep apnea or sleep disordered breathing?

◯ Yes ◯ No

I yawn often

◯ 1 (Never) ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10 (Always yawning)

When I see or hear someone else yawn, I will yawn too

◯ 1 (Never)
◯ 2
◯ 3
◯ 4
◯ 5
◯ 6
◯ 7
◯ 8
◯ 9
◯ 10 (Every time)

Recent Risk of Dozing Off (ESS)

How likely are you to doze off or fall asleep in the following situations, in contrast to just feeling tired? This refers to your usual way of life in the last two weeks. Even if you have not done some of these things recently, try to work out how they would have affected you. Use the following scale to choose the most appropriate number for each situation.

0 - Would never doze
1 - Slight chance of dozing
2 - Moderate chance of dozing
3 - High chance of dozing

	Would never doze (0)	Slight chance of dozing (1)	Moderate chance of dozing (2)	High chance of dozing (3)
1. Sitting and reading	◯	◯	◯	◯
2. Watching TV	◯	◯	◯	◯
3. Sitting, inactive in a public place (e.g. a theater or meeting)	◯	◯	◯	◯
4. As a passenger in a car for an hour without a break	◯	◯	◯	◯
5. Lying down to rest in the afternoon when circumstances permit	◯	◯	◯	◯
6. Sitting and talking to someone	◯	◯	◯	◯
7. Sitting quietly after a lunch without alcohol	◯	◯	◯	◯

8. In a car, while stopped for a few minutes in traffic	○	○	○	○

Source: Johns MW. A new method for measuring daytime sleepiness: The Epworth Sleepiness Scale. Sleep 1991; 14(6): 540-5.

MEQ

SUBJECT:_____ DATE: _____/_____/_____

1. Considering only your own "feeling best" rhythm, at what time would you get up if you were entirely free to plan your day?
   - _____5:00 - 6:30 AM
   - _____6:30 - 7:45 AM
   - _____7:45 - 9:45 AM
   - _____9:45 - 11:00 AM
   - _____11:00 AM - 12:00 PM

2. Considering only your own "feeling best" rhythm, at what time would you go to bed if you were entirely free to plan your evening?
   - _____8:00 - 9:00 PM
   - _____9:00 - 10:15 PM
   - _____10:15 PM - 12:30 AM
   - _____12:30 - 1:45 AM
   - _____1:45 - 3:00 AM

3. If there is a specific time at which you have to get up in the morning, to what extent are you dependent on being woken up by an alarm clock?
   - _____not at all dependent
   - _____slightly dependent
   - _____fairly dependent
   - _____very dependent

4. Assuming adequate environmental conditions, how easy do you find getting up in the mornings?
   - _____not at all easy
   - _____not very easy
   - _____fairly easy
   - _____very easy

5. How alert do you feel during the first half hour after having woken in the mornings?
   - _____not at all alert
   - _____slightly alert
   - _____fairly alert
   - _____very alert

6. How is your appetite during the first half-hour after having woken in the mornings?
   - _____very poor
   - _____fairly poor
   - _____fairly good
   - _____very good

7. During the first half-hour after having woken in the morning, how tired do you feel?
   - _____very tired
   - _____fairly tired
   - _____fairly refreshed
   - _____very refreshed

8. When you have no commitments the next day, at what time do you go to bed compared to your usual bedtime?

_____seldom or never later
_____less than one hour later
_____1-2 hours later
_____more than two hours later

9. You have decided to engage in some physical exercise. A friend suggests that you do this one hour twice a week and the best time for him is between 7:00-8:00 AM. Bearing in mind nothing else but your own "feeling best" rhythm how do you think you would perform?
____would be in good form
_____would be in reasonable for
_____would find it difficult
_____would find it very difficult

10. At what time in the evening do you feel tired and as a result in need of sleep?
_____8:00 - 9:00 PM
_____9:00 - 10:15 PM
____10:15 PM - 12:45 AM
____12:45 - 2:00 AM
____2:00 - 3:00 AM

11. You wish to be at your peak performance for a test which you know is going to be mentally exhausting and lasting for two hours. You are entirely free to plan your day and considering only your own "feeling best" rhythm which ONE of the four testing times would you choose?
_____8:00 - 10:00 AM
_____11:00 AM - 1:00 PM
_____3:00 - 5:00 PM
_____7:00 - 9:00 PM

12. If you went to bed at 11:00 PM at what level of tiredness would you be?
_____not at all tired
_____a little tired
_____fairly tired
_____very tired

13. For some reason you have gone to bed several hours later than usual, but there is no need to get up at any particular time the next morning. Which ONE of the following events are you most likely to experience?
_____will wake up at usual time and will NOT fall asleep
_____will wake up at usual time and will doze thereafter
_____will wake up at usual time but will fall asleep again
_____will NOT wake up until later than usual

14. One night you have to remain awake between 4:00 - 6:00 AM in order to carry out a night watch. You have no commitments the next day. Which ONE of the following alternatives will suit you best?
_____would NOT go to bed until watch was over
_____would take a nap before and sleep after
_____would take a good sleep before and nap after
_____would take ALL sleep before watch

15. You have to do two hours of hard physical work. You are entirely free to plan your day and considering only your own "feeling best" rhythm which ONE of the following times would you choose?
    _____8:00 - 10:00 AM
    _____11:00 AM - 1:00 PM
    _____3:00 - 5:00 PM
    _____7:00 - 9:00 PM

16. You have decided to engage in hard physical exercise. A friend suggests that you do this for one hour twice a week and the best time for him is between 10:00 - 11:00 PM. Bearing in mind nothing else but your own "feeling best" rhythm how well do you think you would perform?
    _____would be in good form
    _____would be in reasonable form
    _____would find it difficult
    _____would find it very difficult

17. Suppose that you can choose your own work hours. Assume that you worked a FIVE-hour day (including breaks) and that your job was interesting and paid by results. During which time period would you want that five consecutive hours to END?
    _____12:00 - 4:00 AM
    _____4:00 - 8:00 AM
    _____8:00 - 9:00 AM
    _____9:00 AM - 2:00 PM
    _____2:00 - 5:00 PM
    _____5:00 PM - 12:00 AM

18. At what time of the day do you think that you reach your "feeling best" peak?
    _____12:00 - 5:00 AM
    _____5:00 - 8:00 AM
    _____8:00 - 10:00 AM
    _____10:00 AM - 5:00 PM
    _____5:00 - 10:00 PM
    _____10:00 PM - 12:00 AM

19. One hears about "morning" and "evening" types of people. Which ONE of these types do you consider yourself to be?
    _____definitely a "morning" person
    _____rather more a "morning" than an "evening" type
    _____rather more an "evening" than a "morning" type
    _____definitely an "evening" type

FOSQ

Study ID _____ Date_____

Some people have difficulty performing everyday activities when they feel tired or sleepy. The purpose of this questionnaire is to find out if you generally have difficulty carrying out certain activities because you are too sleepy or tired. In this questionnaire, when the words “sleepy” or “tired” are used, it means the feeling that you can’t keep your eyes open, your head is droopy, that you want to “nod off”, or that you feel the urge to take a nap. These words do not refer to the tired or fatigued feeling you may have after you have exercised.

Please circle one answer for each question. Please try to be as accurate as possible.

0 – I don’t do this activity for other reasons
1 – No difficulty
2 – Yes, a little difficulty
3 – Yes, Moderate difficulty
4 – Yes, Extreme difficulty

1. Do you generally have difficulty concentrating on things you do because you are sleepy or tired?	0	1	2	3	4
2. Do you generally have difficulty remembering things because you are sleepy or tired?	0	1	2	3	4
3. Do you have difficulty finishing a meal because you become sleepy or tired?	0	1	2	3	4
4. Do you have difficulty working on a hobby (for example: sewing, collecting, gardening) because you are sleepy or tired?	0	1	2	3	4
5. Do you have difficulty doing work around the house (for example: cleaning house, doing laundry, taking out the trash, repair work) because you are sleepy or tired?	0	1	2	3	4
6. Do you have difficulty operating a motor vehicle for short distances (less than 100 miles) because you become sleepy or tired?	0	1	2	3	4
7. Do you have difficulty operating a motor vehicle for long distances (greater than 100 miles) because you become sleepy or tired?	0	1	2	3	4
8. Do you have difficulty getting things done because you are too sleepy or tired to drive or take public transportation?	0	1	2	3	4
9. Do you have difficulty take care of financial affairs and doing paperwork (for example: writing checks, paying bills, keeping financial records, filling out tax forms, etc.) because you are sleepy or tired?	0	1	2	3	4
10. Do you have difficulty performing employed or volunteer work because you are sleepy or tired?	0	1	2	3	4
11. Do you have difficulty maintaining a telephone conversation because you become sleepy or tired?	0	1	2	3	4

0 – I don’t do this activity for other reasons

1 – No difficulty
2 – Yes, a little difficulty
3 – Yes, Moderate difficulty
4 – Yes, Extreme difficulty

12. Do you have difficulty visiting with your family or friends in **your** home because you become sleepy or tired?	0	1	2	3	4
13. Do you have difficulty visiting with your family or friends in **their** homes because you become sleepy or tired?	0	1	2	3	4
14. Do you have difficulty doing things for your family or friends because you become sleepy or tired?	0	1	2	3	4
15. Has your relationship with family, friends or work colleagues been affected because you are sleepy or tired?	0	1	2	3	4
16. Do you have difficulty exercising or participating in a sporting activity because you are too sleepy or tired?	0	1	2	3	4
17. Do you have difficulty watching a movie or videotape because you become sleepy or tired?	0	1	2	3	4
18. Do you have difficulty enjoying the theater or a lecture because you become sleepy or tired?	0	1	2	3	4
19. Do you have difficulty enjoying a concert because you become sleepy or tired?	0	1	2	3	4
20. Do you have difficulty watching television because you are sleepy or tired?	0	1	2	3	4
21. Do you have difficulty participating in religious services, meetings or a group club because you are sleepy or tired?	0	1	2	3	4
22. Do you have difficulty being as active as you want to be in the evening because you are sleepy or tired?	0	1	2	3	4
23. Do you have difficulty being as active as you want to be in the morning because you are sleepy or tired?	0	1	2	3	4
24. Do you have difficulty being as active as you want to be in the afternoon because you are sleepy or tired?	0	1	2	3	4
25. Do you have difficulty keeping a pace with others your own age because you are sleepy or tired?	0	1	2	3	4
26. How would you rate yourself in your general level of activity?		1	2	3	4
		1= Very low; 2= Low; 3= Medium; 4= High			
27. Has your intimate or sexual relationship been affected because you are sleepy or tired?	0	1	2	3	4
28. Has your desire for intimacy or sex been affected because you are sleepy or tired?	0	1	2	3	4
29. Has your ability to become sexually aroused been affected because you are sleepy or tired?	0	1	2	3	4
30. Has your ability to have an orgasm been affected because you are sleepy or tired?	0	1	2	3	4

VIII. Preferences

1. Please mark the bubble which best describes your feelings **RIGHT NOW**.

I feel like gambling

not at all ○○○○○○○○○○○○○○○○○○○○○○○○○ very much

I am driving and the light turns yellow. I feel like

stopping ○○○○○○○○○○○○○○○○○○○○○○○○○ accelerating

The lights suddenly go out in an unfamiliar stairwell

I don't move ○○○○○○○○○○○○○○○○○○○○○○○○○ I proceed immediately

I feel like

avoiding everyone ○○○○○○○○○○○○○○○○○○○○○○○○○ taking on the world

I feel like diving from a diving board, which is

very high ○○○○○○○○○○○○○○○○○○○○○○○○○ very low

I like

routine ○○○○○○○○○○○○○○○○○○○○○○○○○ adventure

I seek

the thrill of danger ○○○○○○○○○○○○○○○○○○○○○○○○○ tranquillity

I am in a hurry

I take a dangerous shortcut ○○○○○○○○○○○○○○○○○○○○○○○○○ I take a safe detour

I am open to

negotiation ○○○○○○○○○○○○○○○○○○○○○○○○○ confrontation

I prefer to

direct ○○○○○○○○○○○○○○○○○○○○○○○○○ be supervised

I give priority to

reason ○○○○○○○○○○○○○○○○○○○○○○○○○ action

I like to listen to music

at a loud volume ○○○○○○○○○○○○○○○○○○○○○○○○○ very softly

I am sure of myself

not at all ○○○○○○○○○○○○○○○○○○○○○○○○○ completely

I prefer discussions, which are

animated ○○○○○○○○○○○○○○○○○○○○○○○○○ calm

A hostile situation

weakens me ○○○○○○○○○○○○○○○○○○○○○○○○○ reinforces me

A menacing dog approaches

I confront it ○○○○○○○○○○○○○○○○○○○○○○○○○ I run away

Faced with a potentially dangerous event

I take my time ○○○○○○○○○○○○○○○○○○○○○○○○○ I instantly react

Seeing a person who is drowning, I first

dive in ○○○○○○○○○○○○○○○○○○○○○○○○○ call for help

I prefer work that is

well planned ○○○○○○○○○○○○○○○○○○○○○○○○○ not planned

I am right

all the time ○○○○○○○○○○○○○○○○○○○○○○○○○ never

I emphasize

precision ○○○○○○○○○○○○○○○○○○○○○○○○○ speed

I like to drive

very fast ○○○○○○○○○○○○○○○○○○○○○○○○○ very slow

I like to listen to music with a tempo that is

very slow ○○○○○○○○○○○○○○○○○○○○○○○○○ very fast

I like to take risks

not at all ○○○○○○○○○○○○○○○○○○○○○○○○○ a lot

THANK YOU FOR COMPLETING THIS SURVEY!

Please provide any additional comments below or on the back of the survey, if needed.

PATIENT HEALTH QUESTIONNAIRE (PHQ-9)

SUBJECT #:_____ **DATE:**_____

Over the last *2 weeks,* how often have you been bothered by any of the following problems?
(use "✓" to indicate your answer)

	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself—or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed. Or the opposite – being so figety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead, or of hurting yourself	0	1	2	3
add columns		+	+	

(Healthcare professional: For interpretation of TOTAL, please refer to accompanying scoring card).

TOTAL:

10. If you checked off *any problems,* how *difficult* have these problems made it for you to do your work, take care of things at home, or get along with other people?

- Not difficult at all _____
- Somewhat difficult _____
- Very difficult _____
- Extremely difficult _____

PHQ-9 Patient Depression Questionnaire

For initial diagnosis:

1. Patient completes PHQ-9 Quick Depression Assessment.
2. If there are at least 4 ✓s in the shaded section (including Questions #1 and #2), consider a depressive disorder. Add score to determine severity.

Consider Major Depressive Disorder

- if there are at least 5 ✓s in the shaded section (one of which corresponds to Question #1 or #2)

Consider Other Depressive Disorder

- if there are 2-4 ✓s in the shaded section (one of which corresponds to Question #1 or #2)

Note: Since the questionnaire relies on patient self-report, all responses should be verified by the clinician, and a definitive diagnosis is made on clinical grounds taking into account how well the patient understood the questionnaire, as well as other relevant information from the patient.
Diagnoses of Major Depressive Disorder or Other Depressive Disorder also require impairment of social, occupational, or other important areas of functioning (Question #10) and ruling out normal bereavement, a history of a Manic Episode (Bipolar Disorder), and a physical disorder, medication, or other drug as the biological cause of the depressive symptoms.

To monitor severity over time for newly diagnosed patients or patients in current treatment for depression:

1. Patients may complete questionnaires at baseline and at regular intervals (eg, every 2 weeks) at home and bring them in at their next appointment for scoring or they may complete the questionnaire during each scheduled appointment.
2. Add up ✓s by column. For every ✓: Several days = 1 More than half the days = 2 Nearly every day = 3
3. Add together column scores to get a TOTAL score.
4. Refer to the accompanying **PHQ-9 Scoring Box** to interpret the TOTAL score.
5. Results may be included in patient files to assist you in setting up a treatment goal, determining degree of response, as well as guiding treatment intervention.

Scoring: add up all checked boxes on PHQ-9

For every ✓ Not at all = 0; Several days = 1;
More than half the days = 2; Nearly every day = 3

Interpretation of Total Score

Total Score	Depression Severity
1-4	Minimal depression
5-9	Mild depression
10-14	Moderate depression
15-19	Moderately severe depression
20-27	Severe depression

A2662B 10-04-2005

Session (1 or 2) _____ ID# _____ Date _____ Time _____ AM PM

PITTSBURGH SLEEP QUALITY INDEX

INSTRUCTIONS:
The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, what time have you usually gone to bed at night?

   BED TIME _____

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night?

   NUMBER OF MINUTES _____

3. During the past month, what time have you usually gotten up in the morning?

   GETTING UP TIME _____

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.)

   HOURS OF SLEEP PER NIGHT _____

For each of the remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you . . .

a) Cannot get to sleep within 30 minutes

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

b) Wake up in the middle of the night or early morning

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

c) Have to get up to use the bathroom

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

d) Cannot breathe comfortably

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week_____

e) Cough or snore loudly

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week_____

f) Feel too cold

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week_____

g) Feel too hot

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week_____

h) Had bad dreams

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week_____

i) Have pain

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week_____

j) Other reason(s), please describe_____

_____

How often during the past month have you had trouble sleeping because of this?

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week_____

6. During the past month, how would you rate your sleep quality overall?

Very good _____

Fairly good _____

Fairly bad _____

Very bad _____

7. During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week_____

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week_____

9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

No problem at all _____

Only a very slight problem _____

Somewhat of a problem _____

A very big problem _____

10. Do you have a bed partner or room mate?

No bed partner or room mate _____

Partner/room mate in other room _____

Partner in same room, but not same bed _____

Partner in same bed _____

If you have a room mate or bed partner, ask him/her how often in the past month you have had . . .

a) Loud snoring

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week_____

b) Long pauses between breaths while asleep

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week_____

c) Legs twitching or jerking while you sleep

Not during the past month_____ Less than once a week_____ Once or twice a week_____ Three or more times a week_____

d) Episodes of disorientation or confusion during sleep

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

e) Other restlessness while you sleep; please describe_____

_____

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week_____

Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ: Psychiatry Research, 28:193-213, 1989.

Rivermead Post Concussion Symptoms Questionnaire

Modified (Rpq-3 And Rpq-13)[42] Printed With Permission: Modified Scoring System From Eyres 2005 [28]

Subject ID: Date:

After a head injury or accident some people experience symptoms that can cause worry or nuisance. We would like to know if you now suffer any of the symptoms given below. Because many of these symptoms occur normally, we would like you to compare yourself now with before the accident. For each symptom listed below please circle the number that most closely represents your answer.

0 = not experienced at all
1 = no more of a problem
2 = a mild problem
3 = a moderate problem
4 = a severe problem

Compared with **before** the accident, do you **now** (i.e., over the last 24 hours) suffer from:

	not experienced	no more of a problem	mild problem	moderate problem	severe problem
Headaches	0	1	2	3	4
Feelings of dizziness	0	1	2	3	4
Nausea and/or vomiting	0	1	2	3	4
Noise sensitivity (easily upset by loud noise)	0	1	2	3	4
Sleep disturbance	0	1	2	3	4
Fatigue, tiring more easily	0	1	2	3	4
Being irritable, easily angered	0	1	2	3	4
Feeling depressed or tearful	0	1	2	3	4
Feeling frustrated or impatient	0	1	2	3	4
Forgetfulness, poor memory	0	1	2	3	4
Poor concentration	0	1	2	3	4
Taking longer to think	0	1	2	3	4
Blurred vision	0	1	2	3	4
Light sensitivity (easily upset by bright light)	0	1	2	3	4
Double vision	0	1	2	3	4
Restlessness	0	1	2	3	4
Are you experiencing any other difficulties? Please specify, and rate as above.					
1.	0	1	2	3	4
2.	0	1	2	3	4

Administration only:

RPQ-3 *(total for first three items)*	
RPQ-13 *(total for next 13 items)*	

http://www.maa.nsw.gov.au/default.aspx?MenuID=148

Rivermead Post Concussion Symptoms Questionnaire (cont.)

Modified (Rpq-3 And Rpq-13)[42] Printed With Permission: Modified Scoring System From Eyres 2005 [28]

Administration only

Individual item scores reflect the presence and severity of post concussive symptoms. Post concussive symptoms, as measured by the RPQ, may arise for different reasons subsequent to (although not necessarily directly because of) a traumatic brain injury. The symptoms overlap with broader conditions, such as pain, fatigue and mental health conditions such as depression[72].

The questionnaire can be repeated to monitor a patient's progress over time. There may be changes in the severity of symptoms, or the range of symptoms. Typical recovery is reflected in a reduction of symptoms and their severity within three months.

Scoring

The scoring system has been modified from Eyres, 2005[24].

The items are scored in two groups. The first group (RPQ-3) consists of the first three items (headaches, feelings of dizziness and nausea) and the second group (RPQ-13) comprises the next 13 items. The total score for RPQ-3 items is potentially 0–12 and is associated with early symptom clusters of post concussive symptoms. If there is a higher score on the RPQ-3, earlier reassessment and closer monitoring is recommended.

The RPQ-13 score is potentially 0–52, where higher scores reflect greater severity of post concussive symptoms. The RPQ-13 items are associated with a later cluster of symptoms, although the RPQ-3 symptoms of headaches, dizziness and nausea may also be present. The later cluster of symptoms is associated with having a greater impact on participation, psychosocial functioning and lifestyle. Symptoms are likely to resolve within three months. A gradual resumption of usual activities is recommended during this period, appropriate to symptoms. If the symptoms do not resolve within three months, consideration of referral for specialist assessment or treatment services is recommended.

References:

Eyres, S., Carey, A., Gilworth, G., Neumann, V., Tennant, A. (2005). Construct validity and reliability of the Rivermead Post Concussion Symptoms Questionnaire. *Clinical Rehabilitation*, 19, 878-887.

King, N. S., Crawford, S., Wenden, F.J., Moss, N.E.G. Wade, D.T. (1995). The Rivermead Post Concussion Symptoms Questionnaire: a measure of symptoms commonly experienced after head injury and its reliability *Journal of Neurology*, 242, 587-592.

Potter, S., Leigh, E., Wade, D., Fleminger, S. (2006). The Rivermead Post Concussion Symptoms Questionnaire *Journal of Neurology*, October 1-12.

Beck Depression Inventory (BDI-II)

Participant ID

_____

Beck Depression Inventory (BDI-II)

Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the one statement in each group that best describes the way you have been feeling during the past two weeks, including today. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleeping Pattern) or Item 18 (Changes in Appetite).

1. Sadness

◯ I do not feel sad. (0)
◯ I feel sad much of the time. (1)
◯ I am sad all the time. (2)
◯ I am so sad or unhappy that I can't stand it. (3)

2. Pessimism

◯ I am not discouraged about my future. (0)
◯ I feel more discouraged about my future than I used to be. (1)
◯ I do not expect things to work out for me. (2)
◯ I feel my future is hopeless and will only get worse. (3)

3. Past Failure

◯ I do not feel like a failure. (0)
◯ I have failed more than I should have. (1)
◯ As I look back, I see a lot of failures. (2)
◯ I feel I am a total failure as a person. (3)

4. Loss of Pleasure

◯ I get as much pleasure as I ever did from the things I enjoy. (0)
◯ I don't enjoy things as much as I used to. (1)
◯ I get very little pleasure from the things I used to enjoy. (2)
◯ I can't get any pleasure from the things I used to enjoy. (3)

5. Guilty Feelings

◯ I don't feel particularly guilty. (0)
◯ I feel guilty over many things I have done or should have done. (1)
◯ I feel quite guilty most of the time. (2)
◯ I feel guilty all of the time. (3)

6. Punishment Feelings

◯ I don't feel I am being punished. (0)
◯ I feel I may be punished. (1)
◯ I expect to be punished. (2)
◯ I feel I am being punished. (3)

7. Self-Dislike

◯ I feel the same about myself as ever. (0)
◯ I have lost confidence in myself. (1)
◯ I am disappointed in myself. (2)
◯ I dislike myself. (3)

8. Self-Criticalness

◯ I don't criticize or blame myself more than usual. (0)
◯ I am more critical of myself than I used to be. (1)
◯ I criticize myself for all of my faults. (2)
◯ I blame myself for everything bad that happens. (3)

9. Suicidal Thoughts or Wishes

◯ I don't have any thoughts of killing myself. (0)
◯ I have thoughts of killing myself, but I would not carry them out. (1)
◯ I would like to kill myself. (2)
◯ I would kill myself if I had the chance. (3)

10. Crying

◯ I don't cry anymore than I used to. (0)
◯ I cry more than I used to. (1)
◯ I cry over every little things. (2)
◯ I feel like crying, but I can't. (3)

11. Agitation

◯ I am no more restless or wound up than usual. (0)
◯ I feel more restless or wound up than usual. (1)
◯ I feel so restless or agitated that it's hard to stay still. (2)
◯ I am so restless or agitated that I have to keep moving or doing something. (3)

12. Loss of Interest

◯ I have not lost interest in other people or activities. (0)
◯ I am less interested in other people or things than before. (1)
◯ I have lost most of my interest in other people or things. (2)
◯ It's hard to get interested in anything. (3)

13. Indecisiveness

◯ I make decisions about as well as ever. (0)
◯ I find it more difficult to make decisions than usual. (1)
◯ I have much greater difficulty in making decisions than I used to. (2)
◯ I have trouble making any decisions. (3)

14. Worthlessness

◯ I do not feel I am worthless. (0)
◯ I don't consider myself as worthwhile and useful as I used to. (1)
◯ I feel more worthless as compared to other people. (2)
◯ I feel utterly worthless. (3)

15. Loss of Energy

◯ I have as much energy as ever. (0)
◯ I have less energy than I used to have. (1)
◯ I don't have enough energy to do very much. (2)
◯ I don't have enough energy to do anything. (3)

16. Changes in Sleep Pattern.

◯ I have not experienced any change in my sleeping pattern. (0)
◯ I sleep somewhat more than usual. (1a)
◯ I sleep somewhat less than usual. (1b)
◯ I sleep a lot more than usual. (2a)
◯ I sleep a lot less than usual. (2b)
◯ I sleep most of the day. (3a)
◯ I wake up 1-2 hours early and can't get back to sleep. (3b)

17. Irritability

◯ I am no more irritable than usual. (0)
◯ I am more irritable than usual. (1)
◯ I am much more irritable than usual. (2)
◯ I am irritable all the time. (3)

18. Changes in Appetite

◯ I have not experienced any change in my appetite. (0)
◯ My appetite is somewhat less than usual. (1a)
◯ My appetite is somewhat more than usual. (1b)
◯ My appetite is much less than before. (2a)
◯ My appetite is much greater than usual. (2b)
◯ I have no appetite at all. (3a)
◯ I crave food all the time. (3b)

19. Concentration Difficulty

◯ I can concentrate as well as ever. (0)
◯ I can't concentrate as well as usual. (1)
◯ It's hard to keep my mind on anything for very long. (2)
◯ I find I can't concentrate on anything. (3)

20. Tiredness or Fatigue

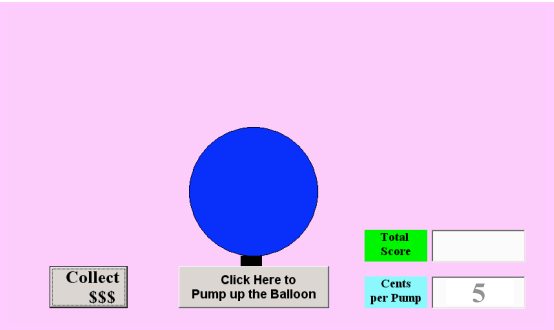
◯ I am no more tired or fatigued than usual. (0)
◯ I get more tired or fatigued more easily than usual. (1)
◯ I am too tired or fatigued to do a lot of the things I used to do. (2)
◯ I am too tired or fatigued to do most of the things I used to do. (3)

21. Loss of Interest in Sex

◯ I have not noticed any recent change in my interest in sex. (0)
◯ I am less interested in sex than I used to be. (1)
◯ I am much less interested in sex now. (2)
◯ I have lost interest in sex completely. (3)

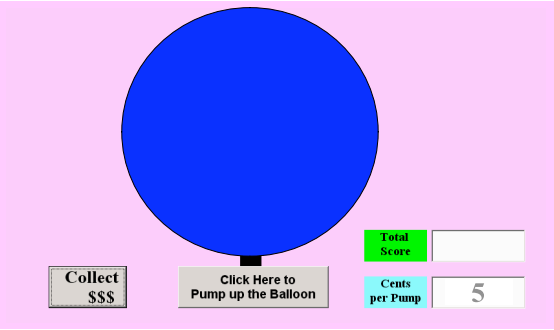
Balloon Analog Risk Task

Inflate Balloon by Pressing Key



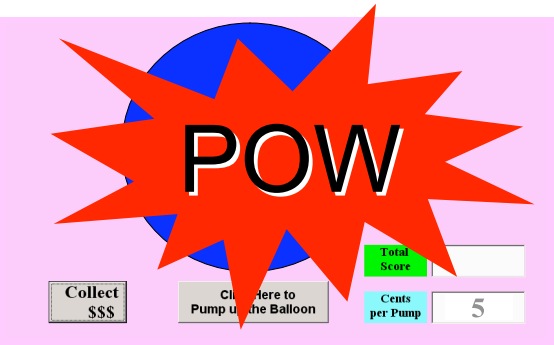
- The BART presents participants with 30 virtual balloons.
- Each balloon can be inflated one increment for each key press.

Balloon Grows in Size and $$$ Value



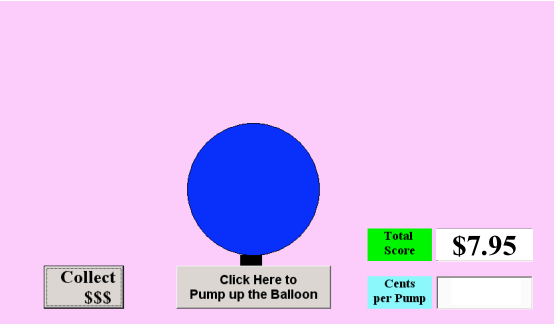
- With each key press the size of the balloon increases.
- Each increment also increases the potential value of the balloon by 5 cents.
- The balloon can be "cashed in" at any time and the total accumulated value retained.

If Balloon Explodes, All $$$ is Lost



- Each balloon can explode at any time.
- If a balloon explodes, all of the potential money accumulated *for that balloon* will be lost.

Goal: Earn as Much Money as Possible



- The goal is to maximize winnings.
- Only 30 balloons are presented

STAI Form S

Subject #_____ Date:_____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel right now, THAT IS, at this moment.

There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	Not at all	Somewhat	Moderately so	Very much so
1. I feel calm.	1	2	3	4
2. I feel secure.	1	2	3	4
3. I am tense	1	2	3	4
4. I feel regretful	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes.	1	2	3	4
8. I feel rested.	1	2	3	4
9. I feel anxious	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self-confident.	1	2	3	4
12. I feel nervous	1	2	3	4
13. I am jittery	1	2	3	4
14. I feel "high strung"	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried	1	2	3	4
18. I feel over-excited and "rattled".	1	2	3	4
19. I feel joyful.	1	2	3	4
20. I feel pleasant.	1	2	3	4

STAI Form T

Subject #_____ DATE_____

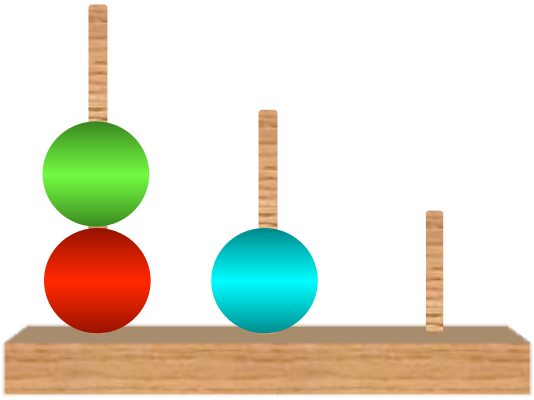
DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you generally feel.

There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

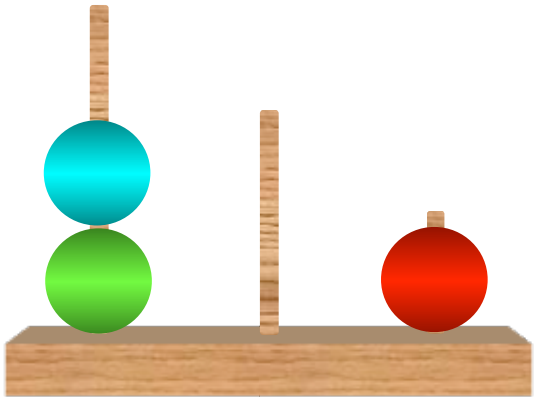
	Almost never	Sometimes	Often	Almost always
21. I feel pleasant	1	2	3	4
22. I tire quickly	1	2	3	4
23. I feel like crying	1	2	3	4
24. I wish I could be as happy as others seem to be	1	2	3	4
25. I am losing out on things because I can't make up my mind soon enough	1	2	3	4
26. I feel rested	1	2	3	4
27. I am "calm, cool, and collected"	1	2	3	4
28. I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
29. I worry too much over something that really doesn't matter	1	2	3	4
30. I am happy	1	2	3	4
31. I am inclined to take things hard	1	2	3	4
32. I lack self-confidence	1	2	3	4
33. I feel secure	1	2	3	4
34. I try to avoid facing a crises or difficulty	1	2	3	4
35. I feel blue	1	2	3	4
36. I am content	1	2	3	4
37. Some unimportant thought runs through my mind and bothers me	1	2	3	4
38. I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
39. I am a steady person	1	2	3	4
40. I get in a state of tension or turmoil as I think over my recent concerns and interests	1	2	3	4

Tower of London Task

Your Tower



Goal



Satisfaction with Life Scale

Below are five statements with which you may agree or disagree.
Indicate your agreement with each item by placing the appropriate number on the line preceding that item.

Please be open and honest in your responding.

The 7-point scale is as follows:

1 = strongly disagree
2 = disagree
3 = slightly disagree
4 = neither agree nor disagree
5 = slightly agree
6 = agree
7 = strongly agree

__ 1. In most ways my life is close to my ideal.
__ 2. The conditions of my life are excellent.
__ 3. I am satisfied with my life.
__ 4. So far I have gotten the important things I want in life.
__ 5. If I could live my life over, I would change almost nothing.

Bright Light Therapy for Treatment of Sleep Problems Following Mild Traumatic Brain Injury

Log Number: PT130230; Award Number: W81XWH-14-1-0571

PI: William D. Killgore, Ph.D **Org:** University of Arizona **Award Amount:** $1,853,909

Study Aims

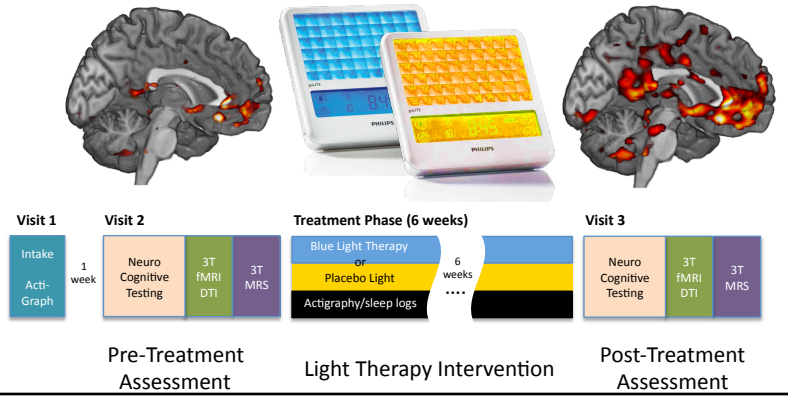
•**Aim 1**: Identify brain regions that are responsive to Blue Light and its association with melatonin changes (localization of effect—Study 1).

•**Aim 2**: Double the pilot study sample size by running an additional 30 participants through a randomized placebo-controlled trial to determine whether 6 weeks of treatment with Blue Light will improve self-reported and objective measures of sleep, brain function, brain structure, and cognitive performance in mTBI patients relative to Amber Light placebo.

Approach

Study 1 : Healthy participants will be exposed to 30 minutes of Blue or Amber light followed by functional MRI scanning and melatonin sampling. **Study 2**: Following MRI scanning and neurocognitive testing, 30 persons with mTBI will be randomly assigned to receive either 6-weeks of morning Blue Light or Amber Placebo light treatment, followed by post-tx scans and assessments. Data will be combined with the data collected from the pilot study to yield a more powerful study (n ≈ 60).

6-week Treatment (n = 15 per group)



Accomplishments: Study 1 (MRI Effect Localization Study) data collection is 100% complete. Two manuscripts have been published, 8 conference abstracts presented, and one thesis completed. Study 2 (main treatment study) is underway with 7 participants completed and 2 underway.

Timeline and Cost

Activities	CY14	CY15	CY16	CY17
Regulatory/IRB/HRPO				
Equipment Procurement				
Hiring/Training				
Data Collection: Study 1				
Data Collection: Study 2				
Analysis/Publication				
Estimated Total Budget ($K)	$154	$615	$617	$468

Updated: 28 OCT 2016

Goals/Milestones

CY14 Goal – Study Preparation
☑Obtain all Regulatory/IRB/HRPO approvals
☑Procure all necessary Equipment/Hire and train all staff/Program Tasks

CY15 Goal – Recruitment and Data Collection
☑Collect All Data for Study 1 (currently 100% completed)
☑Begin Data collection for Study 2 (Main Treatment Study)

CY16 Goal – Continue Data Collection for Study 2
☐Complete at least 80% of data collection for Study 2

CY17 Goal – Complete Data Collection and Analysis
☐Complete 100% of data collection
☐Analyze and Publish findings

Goals/Milestones

- Project is ahead of schedule; 2 papers & 6 abstracts accepted; 1 thesis.

Budget Expenditure to Date
Projected Expenditure: $1,231K
Actual Expenditure: $984K

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Research paper

Exposure to blue wavelength light modulates anterior cingulate cortex activation in response to 'uncertain' versus 'certain' anticipation of positive stimuli

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HIGHLIGHTS

- We compared the effects of thirty minutes of blue versus amber light exposure.
- Participants completed an emotional anticipation task after the light exposure.
- 'Uncertain event' > 'certain reward' led to lower activation for blue vs. amber.
- Blue light may improve adaptive learning-related synaptic processing within the ACC.

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ABSTRACT

Blue wavelength light has been used as an effective treatment for some types of mood disorders and circadian rhythm related sleep problems. We hypothesized that acute exposure to blue wavelength light would directly affect the functioning of neurocircuity implicated in emotion regulation (i.e., ventromedial prefrontal cortex, amygdala, insula, and anterior cingulate cortex [ACC]) during 'certain' and 'uncertain' anticipation of negative and positive stimuli. Thirty-five healthy adults were randomized to receive a thirty-minute exposure to either blue (active) or amber (placebo) light, immediately followed by an emotional anticipation task during functional magnetic resonance imaging (fMRI). In contrast to placebo, participants in the blue light group showed significantly reduced activation within the rostral ACC during 'uncertain' anticipation (i.e., uncertainty regarding whether a positive or negative stimulus would be shown) in comparison to 'certain' anticipation of a positive stimulus. These findings may be explicable in terms of interactions between blue light exposure and the influence of specific neuromodulators on ACC-mediated decision-making mechanisms.

1. Introduction

Daily exposure to bright blue wavelength (≈480 nm) light has been used as a successful treatment for individuals with depression and seasonal affective disorder (SAD) [1]. The mechanisms underlying this effect of blue light on cognition/emotion remain poorly understood but likely include the well known indirect effects of light on the regulation of sleep and circadian rhythms, as well as more direct effects on neurological and neuroendocrine systems [2]. Considerable evidence suggests that the retina contains unique melanopsin photosensitive receptors that respond specifically to the blue wavelengths of light and that these neurons project predominantly to the suprachiasmatic nucleus of the hypothalamus, the primary regulator of circadian rhythms in the brain [3]. However, in addition to the circadian effects of light, some preliminary evidence suggests that light exposure may produce direct and immediate changes in the functioning of neural systems implicated in emotion-related functions. For example, it has been shown that direct exposure to a single dose of blue wavelength light for two hours not only led to improvements in alertness and cognitive performance, but also to increases in subjective wellbeing [4]. This may be explained by the fact that the melanopsin photosensitive ganglion cells also project to brain regions other than the hypothalamus. For example, blue light exposure has been shown to activate

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0304-3940/

the locus coeruleus (LC), which in turn releases norephinephrine throughout the cerebral cortex and influences a variety of brain functions as a result [5,6]. Several functional MRI studies have also suggested that blue light has an effect on emotion-related brain regions. For example, a 3-week daily white light intervention with peaks in the blue spectrum was associated with brain activation changes during perception of angry and fearful faces, including decreased activation within the amygdala and medial prefrontal cortex (mPFC), brain areas critical for the regulation of emotional responses [7]. Another study instead showed that short alternating periods of exposure (i.e., forty seconds) of blue versus green wavelength light were associated with increased activation within the temporal cortex and hippocampus during exposure to threatening versus neutral auditory stimuli [8], and such alternating light exposure produced greater activation within the hypothalamus in patients with SAD in comparison to healthy controls [9]. The inconsistencies in prior research require further exploration but may be due to differences in exposure time, the specific wavelengths used, the visual versus auditory nature of the tasks, differences in the populations or spatial location of the brain regions under investigation. Specifically, it is possible that prolonged daily exposure to blue light has distinct effects on functional brain responses when compared to short bursts of blue light exposure acutely during fMRI scanning, and that blue light has a differential effect in different regions of the brain, as well as in healthy versus clinical populations. However, the limited data on the effects of blue light on functional brain responses currently makes it impossible to draw firm conclusions and further research is necessary to clarify the effects of acute blue light exposure on emotional task responses.

The goal of the present study was to examine the effects of acute exposure to blue wavelength light on immediate post-exposure responses within neural systems implicated in affective regulation. Such systems, which include the amygdala, insula, anterior cingulate cortex (ACC) and ventromedial prefrontal cortex (vmPFC), among others, have been shown to be dysregulated in individuals with depression and anxiety, particularly when perceiving threatening stimuli [10,11] and when anticipating aversive stimuli [12–14]. For most people, uncertainty and unpredictability about the affective nature of future events is aversive, and has been shown to lead to hyperactivation of the insula, amygdala, and ACC relative to expectations about events with high certainty or predictability [15,16]. The ACC in particular appears to play an important regulatory role in decision-making within affective situations; recent models suggest that it does so by integrating information about uncertainty and reward expectations (in part, via dopaminergic reward prediction-error signals it receives from the ventral tegmental area [VTA]), and predicted cost/effort associated with perceptual cues and potential actions [17,18]. These decision-making functions also appear to be optimized via reward prediction-error based learning mechanisms. For example, it has been shown that in anticipation of reward, firing of neurons within the ACC increases as reward approaches [19]; interestingly, depressed individuals show reduced activation of the ACC during reward anticipation [20], and this resolves with successful treatment [21]. Further, synaptic plasticity within the ACC (which may underlie the learning rate within the aforementioned decision-making functions) appears to be facilitated by greater norepinephrine release under conditions of 'certain reward' anticipation [18,22,23]; as blue light is known to increase norepinephrine release from the LC (which itself has extensive projections to the ACC), this suggests that, under such conditions, blue light should increase the synaptic activation within the ACC associated with the integration of reward prediction-error and related learning mechanisms [5,6].

Considering that abnormalities in the processing of reward and uncertainty are implicated in multiple emotion-related psychiatric disorders, and that one major source of unpleasant emotion is uncertainty with respect to affectively significant future outcomes, the aim of this study was to investigate whether the effects of blue wavelength light discussed above might have a modulatory influence on brain responses during the anticipation of 'uncertain events' (i.e., a positive or a negative stimulus) versus 'certain threat' or 'certain reward' events. Specifically, we measured functional brain responses during three conditions of anticipation ('certain threat' cues, 'certain reward' cues, or 'uncertain event' cues) in healthy adults following a single dose of thirty minutes of blue wavelength versus an equal exposure to an amber wavelength light condition. We aimed to explore how exposure to thirty minutes of blue wavelength light would lead to functional brain changes within the amygdala, insula, ACC and mPFC during anticipation of 'certain threat', 'certain reward' and 'uncertain event' stimuli, in comparison to an equal dose of placebo (amber) light.

2. Methods

2.1. Participants

Thirty-five healthy adults who were free from psychiatric, neurological or substance use disorders, and reported a regular sleep schedule of going to bed between 10pm and 1am and waking between 6am and 9am participated in the study. Participants reported sleeping on average 7.2 h (SD = 0.93) per night, and obtained 6.8 (SD = 0.89) h of sleep the night before the assessment. Seventeen participants were randomized to receive thirty minutes of blue wavelength light exposure and eighteen participants were randomized to receive thirty minutes of placebo light exposure (see below). Groups did not differ regarding age, sex, BDI-II scores, number of hours slept on weeknights, and number of hours slept the night prior to assessment (see Table 1). All participants provided written informed consent. The research protocol was reviewed and approved by the Institutional Review Board of the University of Arizona and the U.S. Army Human Research Protections Office.

2.2. Materials

2.2.1. Light exposure

Participants were randomized to receive either thirty minutes of blue wavelength light or placebo amber wavelength light while sitting a darkened room. Blue light was administered by four commercially available Philips goLITE BLU® Energy Light devices (Model HF3321/60; Philips Electronics, Stamford, CT), mounted on a desk at a distance of 80 cm, with each light centered at a 45° angle from midline. Each device consisted of a plastic table-mounted device with a 10 × 6 array of light emitting diodes (LEDs), encased in 1 × 1 cm cubical projection elements and a translucent plastic window cover. The goLITE BLU is commercially available and has a narrow bandwidth (peaking at λ = 469 nm, at 214 Lux, and panel irradiance (mW/cm^2) = 1.23 at 20 cm). The amber placebo devices were provided by the manufacturer for research purposes and were essentially identical to the goLite BLU devices, with the exception that they were fitted with amber LEDs (peaking at λ = 578 nm, at 188 Lux, and total irradiance (mW/cm^2) = 0.35).

2.2.2. Emotional anticipation task

The Emotional Anticipation Task (EAT) was designed to evaluate the brain activation associated with anticipating a positive, negative, or uncertain stimulus. The task was adapted from Aupperle et al.'s [24] study design and lasted a total of 460 s. Participants completed the task in the MRI scanner by viewing images on a translucent projection screen and viewed through the mirror mounted on the head coil. For each trial, participants were presented with a grey background with a black arrow that alternated

Table 1
Participant Characteristics.

	Blue group (n = 17) Mean (SD)	Amber group (n = 18) Mean (SD)	Statistic
Age	21.59 (2.59)	21.78 (3.54)	t (33) = 0.17 p = 0.86
Sex	47% female	55% female	χ^2 = 0.25, p = 0.61
BDI-II	2.82 (3.45)	3.39 (4.04)	t (33) = 0.44, p = 0.66
Number of hours slept on weeknights	7.13 (0.86)	7.27 (1.01)	t (33) = 0.45, p = 0.65
Number of hours slept the night prior to the assessment	6.92 (0.91)	6.71 (0.88)	t (33) = 0.69, p = 0.49

randomly pointing either left or right (baseline condition). For each image, participants were instructed to indicate via button press the direction the arrow was pointing. Participants were told that occasionally the screen color would change to signify that another type of image was to follow. Specifically, when the screen turned yellow, a negative picture would soon appear ('certain threat' anticipation). If the screen turned blue, a positive picture would soon appear ('certain reward' anticipation), and if the screen turned green, either a positive *or* a negative picture would soon appear ('uncertain event' anticipation). The anticipation period always lasted 6 s, and the baseline period varied in duration from 4 s to 8 s. Each anticipation condition was presented 9 times in pseudorandom order and each anticipation period was preceded by a baseline condition. The picture stimuli were presented for 2 s each and consisted of positive and negative pictures from the International Affective Picture System (IAPS). The most unpleasant (e.g., mutilated bodies) (mean valence = 1.62, SD = 1.09, mean arousal = 6.87, SD = 2.14) as well as the most pleasant (e.g., animals) pictures (mean valence ratings = 7.48, SD = 1.53 mean arousal = 5.42, SD = 2.29) were chosen from the picture set.

2.2.3. Beck depression inventory (BDI-II)

The Beck Depression Inventory (BDI-II; [25]) is a 21-item self-report questionnaire to assess depressive symptoms within the last 2 weeks.

2.3. Procedure

Participants completed the study on an individual basis, but each participant was run at the same time each day to minimize circadian effects. Participants arrived for the study at 0745 and were escorted to the laboratory. For the next 1.5 h, participants completed the informed consent process, filled out some basic information questionnaires, and completed the BDI-II. At approximately 0915, participants were then fitted with blue light blocking glasses (to minimize extraneous blue light exposure) and escorted to the neuroimaging center at the University of Arizona Department of Medical Imaging. To ensure that residual effects of outdoor and ambient lighting had dissipated before the beginning of the light exposure period, all participants underwent a "blue-light washout" period for thirty minutes, beginning at 0945. During this period, participants were seated comfortably in a darkened room, without the light blocking glasses, with two amber lights activated on the desk in front of them at 45° to the left and right of center. Participants were instructed not to look directly at the lights, but to relax with their eyes open. At 1015, the thirty-minute active light condition was initiated by engaging four light devices (either blue or amber, depending on condition), which were mounted on the desk in front of the participant. At the completion of the active light condition, participants again donned their blue blocking glasses and were escorted to the MRI scanner. Once in the scanner, the glasses were removed. The scanning sequence, including the EAT was initiated at 1100 and completed by 1200. At the conclusion of the scan, participants completed a few more questionnaires and were released.

2.4. Neuroimaging methods

Participants underwent neuroimaging on a Skyra 3T scanner (Siemens, Erlangen, Germany) using a 32-channel head coil. Structural images were first acquired using a T1-weighted 3D MPRAGE sequence (TR/TE/flip angle = 2.1 s/2.33 ms/12°) over 176 sagittal slices (256 × 256) and a slice thickness of 1.00 mm (voxel size = 1 × 1 × 1). T2*-weighted functional MRI scans were collected over 32 transverse slices and a slice thickness of 2.5 mm using an interleaved sequence (TR/TE/flip angle = 2.0 s/25.0 ms/90°) with 230 images collected per slice. Data were collected with a 22.0 cm field of view and a 64 × 64 acquisition matrix.

2.5. Image processing

Processing and analysis of neuroimaging scans was conducted in SPM12 (Wellcome Department of Cognitive Neurology, London, UK; http://www.fil.ion.ucl.ac.uk/spm). Raw functional images were first realigned and unwarped. The mean functional images was then coregistered to each subject's MRPAGE image in accordance with standard algorithms. Images were then normalized from native space to Montreal Neurological Institute (MNI) coordinate space using forward deformation fields. Finally, images were spatially smoothed (6 mm full-width at half maximum), and resliced to 2 × 2 × 2 mm voxels. The standard canonical hemodynamic response function in SPM was employed, serial autocorrelation was corrected with the AR(1) function, and low-frequency confounds were minimized with a 128-second high-pass filter. The Artifact Detection Tool (http://www.nitrc.org/projects/artifact_detect/) was used to regress out scans exceeding 3 SD in mean global intensity and scan-to-scan motion that exceeded 1.0 mm.

2.6. Statistical analysis

On an individual basis, a general linear model was specified to contrast activation between all anticipation periods and baseline periods, as well as between the anticipation periods themselves. These contrast images were entered into a second-level independent samples t-test analysis with light group as the independent variable. Based on our a priori hypotheses, bilateral search territories were created using the Wake Forest University PickAtlas Utility [26] and the boundaries defined by the Automated Anatomical Labeling Atlas [27], focusing on the vmPFC, amygdala, insula, and ACC bilaterally. Analyses were thresholded at $p < 0.001$ (uncorrected) and subjected to small volume correction for multiple comparisons within each search territory, false discovery rate (FDR) corrected at the cluster level at $p < 0.05$, and k (extent) ≥ 10 contiguous voxels. In order to ensure that the results were not explained by participant's depression scores, which may have an impact on functional brain responses within these areas, analyses were re-run controlling for BDI-II scores.

3. Results

3.1. Anticipation > baseline

There were no significant differences in activation within the a priori ROIs between the two light groups for the following contrasts: 'certain threat' > baseline, 'certain reward' > baseline or 'uncertain event' > baseline.

3.2. Anticipation condition contrasts

There were no significant differences in activation within the ROIs between the two groups for the following contrasts: 'certain threat' > 'certain reward', and 'certain threat' > 'uncertain event'.

3.2.1. 'Uncertain event' > 'certain reward'

For the 'uncertain event' > 'certain reward' contrast, an independent samples *t*-test between the placebo (amber) > blue light group focusing on the a priori ROIs showed a significant difference in activation comprising two large clusters within the left rostral ACC (238 voxels, $p < 0.001$, $t = 4.72$, $x = -6$, $y = 42$, $z = 10$; and 108 voxels, $t = 4.35$, $x = -4$, $y = 42$, $z = -4$). Participants in the blue light condition showed reduced activation within those areas in comparison to participants in the placebo light condition (see Fig. 1).

When controlling for BDI-II scores in the analysis, the difference between the amber versus the blue light group was particularly pronounced for a large cluster within the rostral ACC (560 voxels, $p < 0.001$, cluster-level FDR corrected, and peak-level FWE-corrected at $p = 0.03$; $t = 5.10$, $x = -6$, $y = 42$, $z = 10$).

4. Discussion

In this study we found that a single dose of thirty minutes of blue light exposure immediately preceding the scanning session was associated with a reduced activation difference (relative to amber light exposure) within the left rostral ACC between 'uncertain' anticipation of negative or positive stimuli ('uncertain event' anticipation) and 'certain' anticipation of positive stimuli ('certain reward' anticipation). That is to say, the degree to which left rostral ACC activation was stronger during 'uncertain' than 'certain' anticipation was significantly greater in the amber light condition than the blue light condition. We suggest that this result may be explicable in terms of the known role of the ACC in the integration of uncertainty and valence-related information in decision-making and reinforcement learning.

In particular, we suggest these findings might be explained by the effects of blue light exposure on norepinephrine-mediated increases in learning-related synaptic plasticity within the ACC. The ACC has direct connections with the brainstem, including dopaminergic afferents from the VTA, as well as reciprocal connections with the LC [for a review see Ref. [18]], which releases norepinephrine in response to blue light exposure [5,6]. When exposed to a cue that predicts 'certain reward', dopaminergic neurons will increase their firing rate (i.e., positive reward prediction-error signaling), plausibly leading to an increase in BOLD response within the ACC regions that receive these signals [18]. In the case of the 'certain reward' condition in the present study, participants were told, and would learn quickly, that a blue screen predicts 'reward' in terms of a positive picture. This means that when the reward-predicting blue screen unexpectedly appeared, dopaminergic neuron firing rates in the VTA (signaling positive prediction-error) would increase, leading to a downstream influence on the ACC regions that receive these signals. However, synaptic plasticity (and associated learning rates) in response to such prediction-error signals have also been shown to be facilitated by norephinephrine, which has in turn been shown to be released by the LC in response to blue light exposure [5,22,23]. Thus, blue light, by increasing norepinephrine release in the ACC, may cause an increased 'learning rate' in response to dopaminergic positive reward prediction-error signals (reflected in greater synaptic activation/plasticity), leading to a greater BOLD response within the ACC. This would not be true of the uncertain condition, in which no reward prediction-error signal would be generated (and hence no learning signal would be present for norepinephrine to modulate). In summary, these considerations jointly suggest that individuals in the blue light condition should have exhibited greater synaptic activation (associated with a faster learning rate) when anticipating 'certain reward', due to the increase in norepinephrine, leading to greater BOLD response within the ACC, in comparison to the amber light group. As this increased activation in the certain condition would reduce the difference between the uncertain and certain condition in the blue light group, this would explain why ACC activation in the 'uncertain' > 'certain' contrast is greater in the amber light condition than in the blue light condition. The upshot of this interpretation is that it suggests that blue light may improve adaptive learning-related synaptic processing within the ACC during conditions of expected reward, which could in turn lead to more adaptive decision-making. In contrast, blue light would not be expected to have an effect of this kind in the uncertain condition, as the 'uncertain' cues do not generate prediction-error signal capable of driving learning (i.e., because they do not predict anything reliably about future positive or negative outcomes). However, future research will be necessary to establish whether these findings can be explained by differences in noradrenergic influence, for example, with the use of PET scans.

If blue light does, via its effects on norepinephrine release in the ACC, increase the adaptive use of reward prediction-error signals during learning and decision-making, this could help explain why depression is reduced after continued daily exposure to blue light over time. In particular, it would suggest that blue light exposure could help depressed individuals to become better able to learn from unexpected rewards (and reward-related cues). This may be particularly important in relation to the findings we report here, as the ACC has been identified as an important cortical region that predicts treatment response in mood disorders. For instance, greater ACC activation in anticipation of reward has been shown as a result of successful treatment of depression [21], and greater ACC activation at baseline has been shown to be a predictor of successful treatment response [28]. In the present study, our sample consisted of a healthy, nonclinical population. How these findings might apply to individuals with clinical symptoms of depression remains to be determined. In addition, our study lacks pre- and post-light exposure mood ratings or behavioral responses, it is therefore unclear how the functional brain changes correspond to differences in behavior. However, our findings complement those of previous studies in highlighting the potential of light treatment to improve depressive mood, possibly by changing individuals' internal responses to, and ability to learn from, reward-related processing.

Our results are also consistent with previous findings that showed that a 3-week daily bright light intervention led to reductions in activation within an overlapping medial prefrontal area in response to aversive stimuli [7]. However, as our study included only 30 min of light exposure on a single occasion, this suggests that the effect of blue light may be more immediate than previously thought, and the fact that our study design included positive as well as aversive conditions extends those findings further. This previous study suggested that these findings may reflect increases in emotion regulation abilities, possibly due to differences in neuromodulatory signaling, but proposed that other processes, in particular those involving reward, might also be involved. Our results may therefore compliment those of previous studies, and it should also be noted that the explanation we propose for our

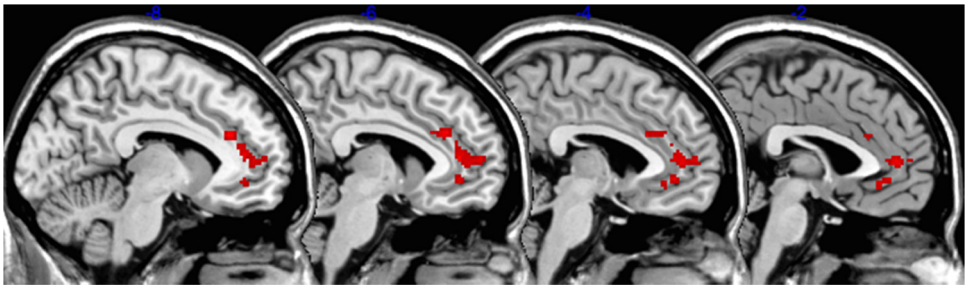

Fig. 1. There was a significantly greater activation difference between 'uncertain event' anticipation > 'certain reward' anticipation in the amber versus the blue light group after 30 min of light exposure within two clusters in the left ACC (MNI: x = −6, y = 42, z = 10, and x = −4, y = 42, z = −4).

results could also relate to emotion regulation. That is, if blue light improves the influence of reward cues on learning and decision-making within the ACC, then it is plausible that this would lead to better emotion regulation-related cognitive/behavior responses. However, as we did not gather behavioral data relevant to decision-making, these ideas will need to be tested in future work. It is also important to highlight that alternative explanations of our results cannot be ruled out. For example, considering the ACC has been shown to be recruited during conditions of unpredictable aversive stimuli [16,29], our results could also reflect a suppression of ACC activation during the 'uncertain event' condition, perhaps suggesting decreased emotional reactivity. Therefore, future research will be necessary to investigate the effects of blue light on ACC activation during emotional tasks in greater detail.

Contrary to our hypotheses, we did not find differences in activation between the two groups within the amygdala or insula during emotional anticipation, although some of these regions have been implicated in previous studies [7,30]. It is possible that the ACC is particularly responsive to the effects of blue wavelength light, because of the immediate increases in norepinephrine due to activation of the LC, whereas other structures require more prolonged daily exposure before functional changes become apparent. Future studies will therefore also need to establish whether this can explain the differences between the present findings and those of previous studies.

5. Conclusion

A single thirty-minute exposure to blue wavelength light versus exposure to a placebo amber wavelength light was associated with a reduced activation difference within the ACC during conditions of 'uncertain event' versus 'certain reward' anticipation. The findings suggest that blue wavelength light has the potential to enhance activation within the ACC during 'certain reward' anticipation, possibly due to an increase in norepinephrine, leading to an increase in the effectiveness of dopaminergic reward prediction-error signals. This increase in the learning rate during reward anticipation may partly explain the beneficial effect of blue light as a treatment for individuals with depression. Future neuroimaging studies including different brain imaging methods (e.g., PET), different functional tasks, and the inclusion of clinical populations will be necessary to illuminate these issues further.

Acknowledgment

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SLEEP COGNITION AND BEHAVIOR

Exposure to Blue Light Increases Subsequent Functional Activation of the Prefrontal Cortex During Performance of a Working Memory Task

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Study Objectives: Prolonged exposure to blue wavelength light has been shown to have an alerting effect, and enhances performance on cognitive tasks. A small number of studies have also shown that relatively short exposure to blue light leads to changes in functional brain responses *during* the period of exposure. The extent to which blue light continues to affect brain functioning during a cognitively challenging task *after* cessation of longer periods of exposure (i.e., roughly 30 minutes or longer), however, has not been fully investigated.

Methods: A total of 35 healthy participants (18 female) were exposed to either blue (469 nm) (n = 17) or amber (578 nm) (n = 18) wavelength light for 30 minutes in a darkened room, followed immediately by functional magnetic resonance imaging (fMRI) while undergoing a working memory task (*N*-back task).

Results: Participants in the blue light condition were faster in their responses on the *N*-back task and showed increased activation in the dorsolateral (DLPFC) and ventrolateral (VLPFC) prefrontal cortex compared to those in the amber control light condition. Furthermore, greater activation within the VLPFC was correlated with faster *N*-back response times.

Conclusions: This is the first study to suggest that a relatively brief, single exposure to blue light has a subsequent beneficial effect on working memory performance, even after cessation of exposure, and leads to temporarily persisting functional brain changes within prefrontal brain regions associated with executive functions. These findings may have broader implication for using blue-enriched light in a variety of work settings where alertness and quick decision-making are important.

Keywords: blue light, amber light, working memory, functional magnetic resonance imaging, fMRI, prefrontal cortex, PFC, N-back task

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Significance

This study shows that exposure to thirty minutes of blue wavelength light in the morning subsequently leads to faster response times on a cognitive working memory task and greater functional brain responses within the prefrontal cortex than comparable exposure to amber light. This is the first study to show that a short, single exposure to blue light during the daytime can lead to enduring measurable changes in brain activation and speed of performance during subsequent completion of a cognitively challenging task. While these findings may have important implications for using blue light in occupational settings, future research will be necessary to establish whether these findings generalize to naturalistic settings.

INTRODUCTION

Exposure to light has important effects on human physiology that are independent of visual perception. These non-image forming effects of light include the regulation of circadian rhythms, melatonin production, changes in core body temperature, sleep propensity, and alertness.[1,2] Many of these effects of light are due to activation of retinal ganglion cells, which are maximally sensitive to light within the short wavelength (~480 nm; blue light). These cells transmit irradiance signals to hypothalamic nuclei (e.g., the suprachiasmatic nucleus [SCN]), which are responsible for regulating circadian rhythms and melatonin production.[1,2] Exposure to blue light in the evening or at night has been shown to increase alertness and improve performance on reaction time tasks, most likely as a result of the suppression of the evening onset of melatonin, which leads to a phase delay of the circadian rhythm.[3–6] In a similar vein, morning blue light exposure suppresses melatonin in the early part of the day and leads to a phase advance of the circadian rhythm by inducing the onset of plasma melatonin earlier in the evening.[7] In addition, blue light, and bright white light exposure more generally, during the day, has also been shown to have beneficial effects on alertness in a number of studies. One study compared the effects of bright (5,000 lux) versus dim light (< 10 lux) exposure during the day (between 12:00 and 16:00) and at night (between 00:00 and 04:00), and found that participants reported lower levels of sleepiness and fatigue, and greater energy during bright versus dim light exposure, regardless of time of day.[8] In addition, the effects of daytime blue light exposure appear to have beneficial effects over longer periods of exposure. In a work place office setting, participants who were exposed to blue-enriched white light during the work day for 4 weeks reported increased subjective alertness, performance, positive mood, and concentration, in comparison to 4 weeks of white light exposure.[9] Further evidence suggests that blue light can also be superior to caffeine for sustaining performance on tasks requiring psychomotor functioning.[10]

While the alerting effects of nighttime exposure to blue light appear to be produced predominantly by the suppression of melatonin, the increases in daytime alertness after blue light exposure are thought to be largely due to effects other than melatonin regulation.[11] In particular, the daytime alerting effect of blue light may come from the indirect effects of melanopsin photosensitive retinal ganglion cells, which also project to brain regions other than the hypothalamus. For example, these cells can also indirectly influence activation of the locus coeruleus (LC),[12] which in turn releases norepinephrine broadly throughout the cerebral cortex,[13] leading to increases in alertness.[14] Such downstream influences may explain some of the effects of blue light on alertness during the daytime, independent of the effects of melatonin. In fact, a functional magnetic resonance imaging (fMRI) study of in-scanner acute light exposure demonstrated that short 50-second bursts of

blue light increased activation within the middle frontal gyrus and the brainstem, in comparison to violet light, while participants completed an auditory working memory task.[15] While precise identification of brainstem nuclei is difficult using fMRI techniques, the location of the activation was consistent with the general stereotaxic coordinates of the LC.[15] Thus, it appears plausible that blue light exposure may result in increased noradrenergic influence over cortical regions involved in controlled cognitive processing.

The aforementioned research suggests that blue light exposure activates brain networks that underlie many aspects of cognitive performance. One especially important cognitive function that may benefit from blue light exposure is working memory. Working memory comprises a set of cognitive processes that allow information to be actively held in mind in order to guide decision-making.[16] Studies of healthy populations as well as patients with brain lesions have shown that working memory performance is associated with increased activation within the prefrontal cortex (PFC), and especially the dorsolateral PFC (DLPFC) and ventrolateral PFC (VLPFC).[16,17] Since blue light exposure appears to influence the LC, which can increase the release of norepinephrine and lead to subsequent neural activation within the PFC, this may plausibly influence neural processes associated with working memory.

Neurocomputational models suggest that decision-making processes, such as those supported by working memory, require a trade-off between speed and accuracy. In this case, either a lot of time is spent to accumulate evidence for "safe and slow" decision-making, or less time is spent for "fast but risky" decision-making.[18] These models also suggest that changes in baseline activation levels, as opposed to changes in the decision-threshold itself, may control this trade-off. For example, increases in baseline activation levels would decrease the distance from threshold, leading to faster but less reliable choices.[18] One might therefore predict that blue light exposure would lead to faster response times within this type of task by increasing baseline activation levels. However, the few studies that have actually examined the effects of blue wavelength light during working memory performance (e.g., an auditory *N*-back task and an oddball task) have not found significant effects in terms of response time or accuracy when compared to non-blue wavelengths, despite significant increases in the activation of arousal and working memory systems of the brain.[15,19,20] It should be noted that the duration of blue light exposure was considerably longer in those behavioral studies[9] mentioned above (where a significant effect on performance was observed) compared to those fMRI studies finding no effect[15,19,20] (one to several hours of blue light exposure in behavioral studies in comparison to 50 seconds up to 21 minutes in fMRI studies). Importantly, a recent review has suggested that the performance-enhancing effects of blue light at night as well as during the day usually occur with an exposure duration of roughly 30 minutes or longer.[21] It is therefore possible that the shorter durations (e.g., 18 minutes) of blue light exposure applied in prior fMRI studies may not have been long enough to induce measurable behavioral changes. Furthermore, it has not been investigated in detail whether blue light exposure has the ability to affect functional brain responses and working memory performance *after* cessation of a single dose of daytime blue light exposure. While it has been shown that self-reported sleepiness is reduced after blue light exposure at nighttime,[3] it is unclear whether a single dose of daytime blue light exposure can lead to enduring effects in terms of cognitive performance and functional brain responses. It is also possible that the lack of findings in previous fMRI studies may have been the result of participants completing the working memory task *during* light exposure, and not afterwards.

The goal of the present study was therefore to examine how 30 minutes of continuous blue wavelength light exposure would affect subsequent working memory performance and associated functional brain responses after cessation of the light exposure. We hypothesized that the enduring effects of blue wavelength light exposure would be associated with greater activation during a working memory task (*N*-back task) within areas usually recruited by such tasks, specifically the DLPFC and VLPFC, and that this increased activation would be associated with faster response times during the task, in comparison to a control exposure of amber light under the same conditions.

METHODS

Participants

Thirty-five healthy 18- to 32-year olds (18 female; 17 male) took part in the study. Participants completed an average of 12.5 years of education, were all right handed, primary English speaking, free from psychiatric, neurological, and substance use disorders, and reported a regular sleep schedule of going to bed between 22:00 and 01:00 and waking between 06:00 and 09:00.

Materials

Light Exposure

Participants underwent the controlled light exposure while sitting in an otherwise completely darkened room. All participants began with a blue light *Washout Period* (described in more detail under Procedure) that involved sitting in a dark room while only exposed to two amber light devices (described below) mounted on a desk at a distance of approximately 80 cm from the participant's nasion, with each light centered at a 45-degree angle from midline (see Figure 1A). Actual distance and angle of the light devices were adjusted manually until the pair of amber devices used during the initial washout period resulted in a 20-lux reading as measured by a light meter (Digital Lux Meter LX1330B) on each side of the participant's nose. During the *Exposure Period,* light was administered by a similar configuration of 4 light devices, also centered at 45 degrees to each side of the participant with a distance of approximately 80 cm from the participant's nasion (see Figure 1B). During the *Exposure Period*, the light devices were either blue or amber depending on random assignment. Blue light exposure utilized an array of commercially available Philips goLITE BLU Energy Light devices (Model HF3321/60; Philips Electronics, Stamford, CT). Each device consisted of a plastic table-mounted chassis with

a 10 × 6 array of light emitting diodes (LEDs), encased in 1 × 1 cm cubical projection elements and a translucent plastic window cover. The goLITE BLU Energy Light is commercially available and has a narrow bandwidth (peaking at λ = 469 nm, at 214 lux, and panel irradiance [mW/cm^2] = 1.23 at 20 cm). The amber devices were provided by the manufacturer for research purposes and were essentially identical to the goLITE BLU devices, with the exception that they were fitted with amber LEDs (peaking at λ = 578 nm, at 188 lux, and total irradiance [mW/cm^2] = 0.35).

N-back Task

This task was used during functional neuroimaging. The *N*-back task is a widely used task for assessing working memory[22] and is typically applied in either auditory or visual modalities. In the present study, we employed a widely used visual variant of the task whereby participants viewed and responded to a series of letters appearing in serial order on the screen.[16] Participants were presented with white letters appearing one letter at a time centered on a black screen. The *N*-back task included 3 conditions of varying cognitive load. During the control condition (i.e., "zero-back"), participants were asked to identify by button press whether each letter on the screen matched a predetermined letter (e.g., "P") by pressing "yes" with their middle finger or "no" with the index finger of their right hand. In the "one-back" condition, participants responded with a button press using their right hand to indicate whether the letter presented in the current trial was identical to the letter presented in the immediately preceding trial. In the same way, during the "two-back" condition, participants indicated whether the letter shown in the current trial was identical to the letter presented 2 letter trials previously. Each cognitive load condition was presented as a block lasting 42 seconds. These blocks each consisted of a 6-s instruction screen followed by 16 trials (trial = stimulus displayed for 500 ms + 1,750 ms blank screen, ISI = 2,250 ms). Each cognitive load block was presented 3 times in pseudo-random order for a total of 9 blocks (3 "zero-back"; 3 "one-back"; 3 "two-back") throughout the task. The task began and ended with a 10-s crosshair image requiring only visual fixation, and each block was also separated by a 10-s crosshair fixation image, for a total task run of 478 seconds (7 min 58 sec). Prior to neuroimaging, participants underwent a practice version of the task outside of the scanner. This involved completing each cognitive load condition once (i.e., 16 trials each) with immediate visual feedback on each trial to ensure that they understood the task before completing it in the scanner. Verbal instructions were given to participants while in the scanner and they were encouraged to ask any questions before beginning the task.

Stanford Sleepiness Scale (SSS)

The Stanford Sleepiness Scale (SSS)[23] is a one-item measure to assess participants' current level of sleepiness on a 1–7 point scale, ranging from "feeling active, vital, alert, or wide awake" to "no longer fighting sleep, sleep onset soon, having dream-like thoughts." Higher scores on the SSS indicate higher levels of sleepiness.

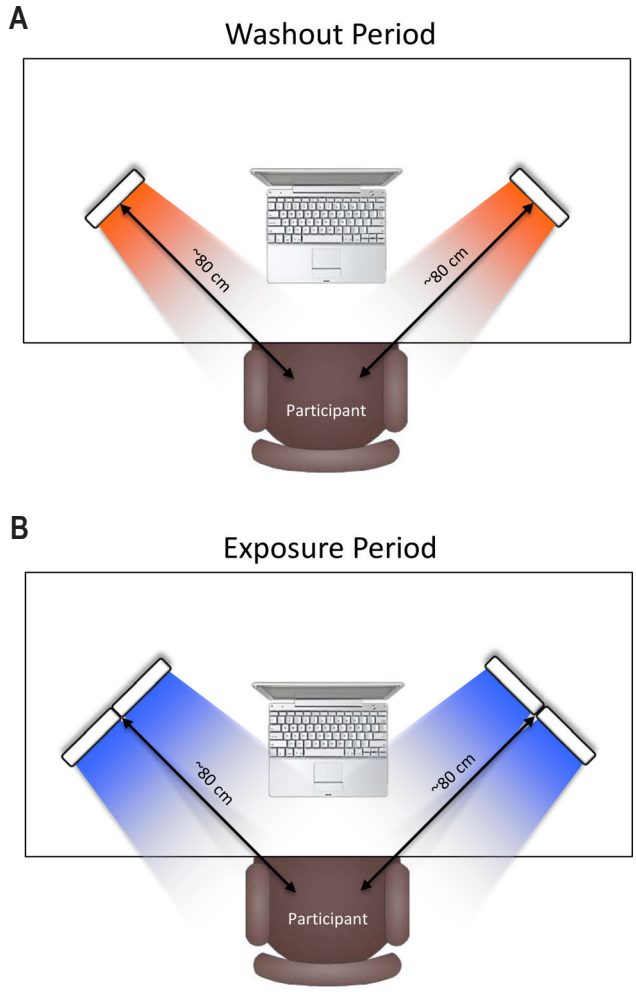

Figure 1—Diagram of light device placements. Participants were seated at a desk in a darkened room with light devices placed at a 45-degree angle to the right and left of center at a distance of approximately 80 cm. **(A)** During the 30-minute blue light Washout Period, 2 devices (one on the left and one on the right) fitted with amber light emitting diodes (LEDs; λ = 578 nm) were directed toward the participant, with each device centered at a 45-degree angle). **(B)** During the 30-minute *Exposure Period*, 4 devices (2 on the left and 2 on the right) were directed toward the participant, with each pair centered at a 45-degree angle. Devices were fitted with either blue (λ = 469 nm) or amber (λ = 578 nm) LEDs, according to random assignment.

Procedure

Participants completed the study on an individual basis, but all participants were run at the same time each day to control for circadian time of day effects. To ensure that participants were not in caffeine withdrawal during the procedure, they were asked to consume their normal levels of morning caffeine before arrival for the study. Participants arrived for the study at 07:45 and were escorted to the laboratory. For the first portion of the day, participants completed the informed consent process, and completed some basic information questionnaires and cognitive tasks. Participants were randomized to receive either 30 min of blue (n = 17) or amber (n = 18) light exposure. At approximately 09:15, participants were then fitted with wrap around polycarbonate blue light-blocking

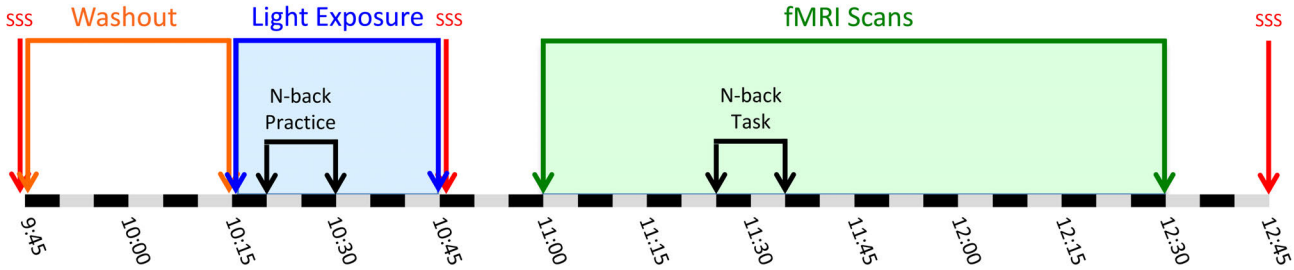

Figure 2—Timeline detailing the study procedure. Between 09:45 and 10:15, participants underwent 30 minutes of "washout" amber light exposure. Immediately following the washout period, participants either received 30 minutes of amber placebo light or blue light exposure (i.e., between 10:15 and 10:45). During this time, at 10:20, participants received instructions on the *N*-back task and completed one practice run, lasting 10 minutes in total. At 11:00, participants began the fMRI scan, and the *N*-back task was initiated at 11:25 and ended at 11:33. The scan ended at 12:30. Participants completed the Stanford Sleepiness Scale (SSS) 3 times during the procedure, including just before the start of the washout period, immediately after the light exposure, and at 12:45 after exiting the fMRI scanner.

glasses (to minimize extraneous blue light exposure) and were escorted to the neuroimaging center at the University of Arizona Department of Medical Imaging. At 09:45, participants then completed the SSS and immediately underwent a "blue light washout" period for 30 min to ensure that residual effects of outdoor and ambient lighting had dissipated before the beginning of the light exposure period. During this washout period, participants were seated comfortably in a darkened room and then removed the light-blocking glasses. Ambient lighting was provided by 2 amber light devices (see Materials), which were activated on the desk in front of the participant and located 45° to the left and right of center, approximately 80 cm from the participant's nasion (see Figure 1A). The amount of light exposure was measured and the lights were adjusted for each participant to ensure that 20 lux of amber light was registered on each side of the nose. Participants were instructed not to look directly at the light devices, and to relax with their eyes open and maintain a generally forward gaze. At 10:15, the 2 Washout Period light devices were replaced with the 4 Exposure Period devices (see Figure 1B). Then the 30-min Exposure Period was initiated by engaging the 2 pairs of light devices (either blue or amber, depending on condition), with each pair mounted side by side on the desk in front of the participant, centered at the same location as the Washout Period amber lights. During the 30-min Exposure and Washout Periods, participants maintained a forward gaze and completed several computerized practice tasks to prepare them for their time in the scanner. The laptop monitors were shielded by an amber colored Plexiglas panel, which was acquired from www.lowbluelights.com, to block blue wavelength light. These computerized practice tasks ranged from 5 to 10 min each and were interspersed with 5-min rest breaks that involved sitting silently and maintaining a forward gaze at a crosshair on the wall facing the participant. At the completion of the Exposure Period (10:45), participants again donned their blue light-blocking glasses, were escorted to the MRI scanner, and again completed the SSS. Once in the scanner, the scanner room lights were dimmed and the glasses were removed. While we have no measurement of the lux levels in the scanner due to the incompatibility of lux meters within the magnetic field of the scanner, the light conditions were held constant across participants. The scanning sequence was initiated at 11:00, and the *N*-back task was started at approximately 11:25, and the scan was completed by 12:30. At the conclusion of the scan, participants exited the scanner and completed one last SSS (10:45) and were released. Figure 2 details the timeline of the study procedure.

Ethical Considerations

The research protocol was reviewed and approved by the Institutional Review Board of the University of Arizona and the U.S. Army Human Research Protections Office.

Neuroimaging Methods

Participants underwent fMRI immediately after completion of the 30-min exposure to either blue or amber light. Neuroimaging scans were collected on a Skyra 3T scanner (Siemens, Erlangen, Germany) using a 32-channel head coil. Structural images were first acquired using a T1-weighted 3D MPRAGE sequence (TR / TE / flip angle = 2.1 s / 2.33 ms / 12 degree) over 176 sagittal slices (256 × 256) and a slice thickness of 1.00 mm (voxel size = 1 × 1 × 1). T2*-weighted functional MRI scans were collected over 32 transverse slices and a slice thickness of 2.5 mm using an interleaved sequence (TR / TE / flip angle = 2.0 s / 25.0 ms / 90 degree) with 239 images collected per slice. Data were collected with a 22.0 cm field of view and a 64 × 64 acquisition matrix.

Image Processing

Processing and analysis of neuroimaging scans was conducted in SPM12 (Wellcome Department of Cognitive Neurology, London, UK; http://www.fil.ion.ucl.ac.uk/spm). Raw functional images were first preprocessed by realigning and unwarping the functional images, and then co-registering the newly created mean functional image to each subject's structural T1 scan. Forward deformation fields were used to normalize the images from subject native space to Montreal Neurological Institute (MNI) coordinate space. Finally, the images were spatially smoothed (6 mm full-width at half maximum), and resliced to 2 × 2 × 2 mm voxels. A high pass

Table 1—Sample characteristics.

	Blue group (n = 17) Mean (SD)	Amber group (n = 18) Mean (SD)	Statistic
Age	21.71 (2.58)	22.22 (4.06)	$t_{33} = 0.63$, P = 0.53
Gender	47% female	55% female	$\chi^2 = 0.25$, P = 0.62
Years of Education	12.71 (3.58)	12.44 (3.34)	$t_{33} = 0.22$, P = 0.26
Mean hours of sleep on a weeknight	7.25 (0.97)	7.22 (0.94)	$t_{33} = 0.09$, P = 0.93
Hours of sleep the night before the assessment	6.88 (0.54)	6.86 (0.87)	$t_{33} = -0.09$, P = 0.93
Mean number of caffeinated products per day	0.78 (0.81)	1.08 (0.97)	$t_{33} = -0.97$, P = 0.34
Typical wake time on weeknights	07:52 (0:56)	07:24 (1:05)	$t_{33} = -0.13$, P = 0.19
Typical bed time on weeknights	23:40 (1:12)	23:25 (0:56)	$t_{33} = -0.70$, P = 0.48
SSS pre-washout	1.69 (0.87)	1.89 (0.58)	$F_{2, 32} = 0.63$, P = 0.43
SSS post-exposure	2.38 (1.25)	2.78 (1.14)	$F_{2, 32} = 0.98$, P = 0.33
SSS post-fMRI scan	1.94 (1.12)	2.11 (1.27)	$F_{2, 32} = 0.17$, P = 0.67

SSS, Stanford Sleepiness Scale.

filter with a 128-s cutoff period was used to remove low frequency confounds. The standard canonical hemodynamic response function in SPM was employed, and serial autocorrelation was corrected with an autoregressive model of 1 (+white noise). Motion artifacts exceeding 3 SD in mean global intensity and scan-to-scan motion that exceed 1.0 mm were regressed out using the Artifact Detection Tool (http://www.nitrc.org/projects/artifact_detect/).

Statistical Analysis

On an individual basis, a general linear model (GLM) was specified to contrast activation between the two-back > zero-back condition. These contrast images were entered into a second-level independent samples t-test analysis with light group (blue versus amber) as the independent variable. Based on our *a priori* hypotheses and previous findings from a large meta-analysis of normative functional neuroimaging studies using the *N*-back task,[16] spheres of a 10 mm radius centered on stereotaxic coordinates derived from the previous meta-analysis were placed in areas of the DLPFC and VLPFC. The Talairach coordinates reported in Owen et al.[16] were transformed to MNI coordinates using the MNI2TAL online program from Lacadie et al.[24] (http://sprout022.sprout.yale.edu/mni2tal/mni2tal.html). The following MNI coordinates were used: DLPFC (x = 41, y = 31, z = 30; x = −37, y = 45, z = 21; x = −46, y = 19, z = 22), and VLPFC (x = −31, y = 21, z = 4; x = 34, y = 23, z = 1). Analyses were thresholded at P < 0.001 (uncorrected) and subjected to small volume correction for multiple comparisons within each search territory, family wise error (FWE) corrected at P < 0.05, and *k* (extent) ≥ 10 contiguous voxels.

In addition to the primary analysis of our hypothesized effects, we also conducted an exploratory whole brain analysis to provide complete data for future hypothesis generation. Here, we used a slightly more liberal height threshold of P < 0.005, while protecting against type I error through a cluster-corrected extent threshold of 201 voxels, which represents an FWE correction of P < 0.05.[25] Because this analysis was exploratory, we had no *a priori* hypothesis and merely present these supplemental findings for completeness and to obviate bias in reporting.

RESULTS

Descriptive Statistics

According to self-report, participants slept on average 7.2 h (SD 0.94) per night, and obtained 6.8 h (SD 0.72) of sleep the night before the assessment. Participants reported going to bed on average at 23:32 (SD 1 h 4 min) and waking at 07:37 (SD 1 h 2 min) on weekdays. Participants reported drinking an average of 0.93 (SD 0.89) caffeinated products per day, and 8 participants (4 in each group) reported having had one caffeinated product prior to the assessment, which was consistent with their normal morning consumption patterns. Groups did not differ on age, gender, years of education, mean number of hours slept on weeknights, number of hours slept the previous night, mean number of caffeinated products per day, and waking and bed times (see Table 1).

Behavioral Results

A repeated-measures ANOVA of the SSS scores showed no interaction between light color and session (pre-washout, post light exposure, and post-fMRI) ($F_{2, 31} = 0.12$, P = 0.88). An analysis of simple effects showed no difference between light color groups at each of the 3 sessions (see Table 1).

There was no difference in accuracy and response time between the blue and amber groups for the zero-back condition, but participants in the blue group responded faster during the one- ($t_{33} = -2.26$, P = 0.03) and two-back conditions ($t_{33} = -1.98$, P = 0.05) than participants in the control group (see Table 2).

Neuroimaging Results

Hypothesis Testing

For the two-back > zero-back contrast, individuals in the blue light group showed significantly greater activation in a cluster within the left DLPFC ($k = 29$; $P_{FWE} = 0.03$; $t = 4.12$; x = −50, y = 14, z = 22, small volume corrected) and a cluster within the right VLPFC ($k = 17$, $P_{FWE} = 0.006$, $t = 4.83$; x = 34, y = 20, z = −6, small volume corrected) than individuals who were exposed to the amber control light (see Figure 3). There were no regions within the brain where amber light exposure was

Table 2—Mean accuracy and reaction times for the *N*-back task.

	Accuracy (SD) in %	Total Reaction Time (SD) in milliseconds	Reaction Time for Correct Responses (SD) in milliseconds
Zero-back			
Blue	96.05 (0.39)	410.72 (97.04)	407.81 (91.55)
Amber	97.43 (0.25)	457.05 (94.07)	458.64 (93.03)
One-back			
Blue	87.31 (0.71)	485.09 (133.81)[a]	485.09 (133.81)[c]
Amber	88.49 (0.82)	601.97 (168.77)[a]	601.97 (168.77)[c]
Two-back			
Blue	88.60 (0.91)	556.00 (196.87)[b]	553.00 (192.05)[†]
Amber	88.74 (1.03)	691.01 (205.59)[b]	682.62 (204.16)[†]

[a], [b], and [c], denote groups that significantly differ at P < 0.05; [†] marginal difference (P = 0.06).

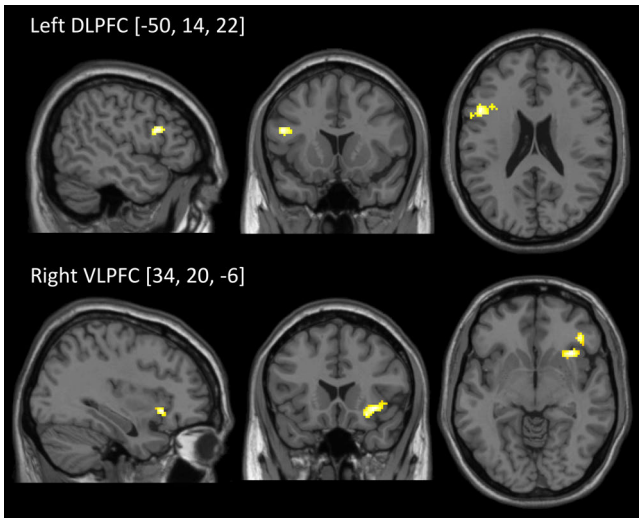

Figure 3—SPM images showing the clusters of significant activation where Blue > Amber for the *N*-Back task (two-back > zero-back). Based on the a priori regions of interest, this comparison revealed that the blue light condition was associated with significantly greater activation within the left dorsolateral prefrontal cortex (DLPFC) and the right ventrolateral prefrontal cortex (VLPFC) when compared to the amber light condition during complex working memory. Clusters are significant at P < 0.05, FWE corrected, but are displayed at P < 0.005 for ease of visualization.

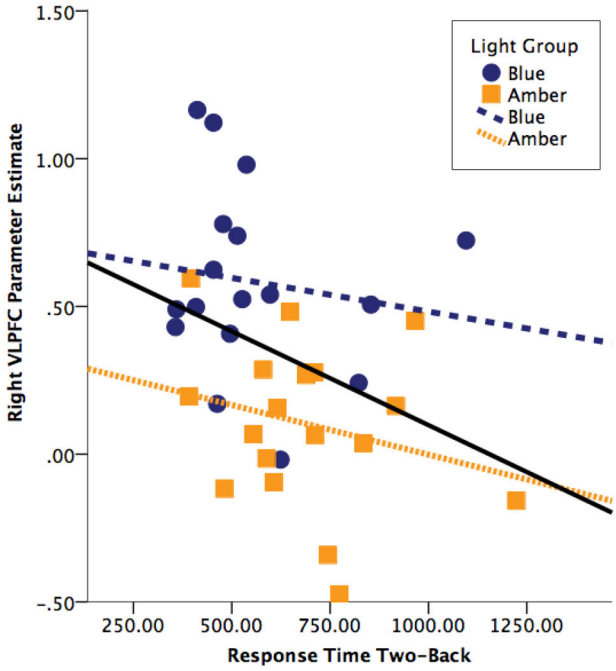

Figure 4—The scatterplots illustrate the association between the activation within the right ventrolateral prefrontal cortex (VLPFC) and reaction time during the two-back condition for the blue and amber light groups, and the sample as a whole.

associated with greater functional brain responses than blue light exposure.

In order to investigate the association between regional activation and behavioral responses, we extracted the activation for the unadjusted cluster eigenvariate for both brain regions and conducted Pearson correlations between the eigenvariate and response time and performance metrics during the two-back condition. There was a negative correlation between VLPFC activation and response time ($r = -0.35$, P = 0.04). This correlation was present among the sample as a whole and was not driven by one group in particular (Figure 4). No significant associations with accuracy were found. In addition, no significant associations were found between activation within the DLPFC and performance on the working memory task.

To investigate whether participants were more "efficient" with increases in working memory (i.e., the number of correct responses per second), a measure of cognitive throughput was calculated ([Accuracy × (1 / RT) * 1,000]).[26] Throughput provides a quantitative metric of the speed versus accuracy tradeoff. While there was no difference in throughput between the 2 groups in the zero-back condition ($t_{33} = -1.60$, P = 0.19), participants in the blue group showed enhanced throughput in the one-back ($t_{33} = -2.57$, P = 0.01), and marginally higher throughput in the two-back condition ($t_{33} = -1.92$, P = 0.06). In other words, participants in the blue light group provided a greater number of correct responses per unit of time than participants in the amber control group (Figure 5). Given that the groups were essentially equivalent with regard to accuracy, this difference suggests that exposure to blue light led to faster response times with no loss in accuracy.

Exploratory Analysis

Finally, exploratory whole brain analysis was undertaken for the purpose of facilitating future hypothesis generation, with a peak height threshold of $P < 0.005$, and cluster-corrected extent threshold of $P < 0.05$ (FWE corrected). Again comparing the two-back > zero-back contrast, we found that the blue-wavelength light exposure group showed significantly greater activation than the amber control group within several distributed regions including left and right VLPFC (i.e., inferior frontal gyrus/insula), left and right middle temporal gyrus, right posterior cingulate gyrus, left middle occipital cortex, brainstem, and thalamus (Figure 6). Table 3 lists the cluster maxima for these exploratory analyses. There were no regions in the brain showing greater activation for the amber control light group compared to blue light group during the working memory task.

DISCUSSION

The goal of the present study was to examine the effects of 30 minutes of controlled blue wavelength (469 nm) light exposure compared to amber placebo light (578 nm) exposure on subsequent functional brain responses and performance during an *N*-back working memory task among healthy non-sleep deprived individuals. We found that exposure to 30 minutes of blue wavelength light produced greater activation within regions of the DLPFC and VLPFC and faster response times during a subsequent working memory task than exposure to amber wavelength light under otherwise identical conditions. Moreover, greater activation in the VLPFC for both groups combined was significantly correlated with faster response times during the working memory task, consistent with this region's role in executive functioning. Finally, while blue light effects were observed for brain activation and response time, there were no group differences in accuracy on the working memory task. Together, these findings suggest that a relatively brief exposure to blue light has an enhancing effect on speeded cognition and brain function that may persist for at least 40 minutes after cessation of the light.

It is well established that both the DLPFC and VLPFC are critically involved in the encoding, retention, and retrieval of information during working memory tasks.[16,27,28] Our findings suggest that a single, relatively short exposure to blue wavelength light of only 30 minutes can increase neural activation over the subsequent 40-minute period within those prefrontal areas most critical for successful working memory performance. Prior work has shown that even short bursts of blue light for periods lasting from 50 seconds to 20 minutes are effective at activating similar regions of the DLPFC and VLPFC during auditory working memory tasks.[15,19,29] While previous studies have found increases within the prefrontal regions *during* exposure,[15,19] this study shows that brain activation and improved working memory task performance as a result of light exposure can substantially endure well beyond the exposure period and adds to emerging work suggesting that prolonged blue light exposure (30 minutes or more) may continue to affect brain function even after termination of the light.[30] Although previous studies suggest that light-induced changes in functional brain responses may decline within 10 minutes after the end of the exposure period,[20] it is important to consider that the duration of the light exposure was considerably shorter, roughly 10 to 29 minutes less time than in the present study.[15,19,20] It is therefore possible that the longer light exposure may have contributed to these differences in findings. However, it should be also pointed out that some of these previous studies may have employed shorter periods of light exposure (e.g., 50 second bursts of exposure[15]) in order to prevent the confounding effects of variations in alertness and performance on the *N*-back task. Future studies comparing varying durations of light exposure, and employing different tasks, will therefore be necessary to determine the

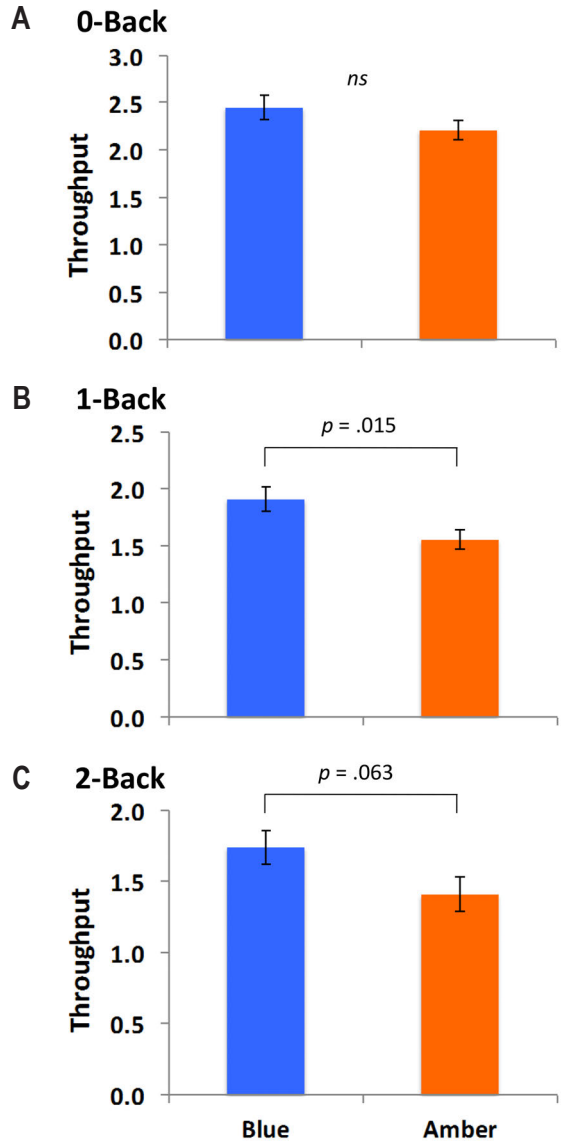

Figure 5—The figure shows group differences in working memory cognitive throughput (Accuracy × [1 / RT] * 1,000), which is a measure of the speed × accuracy trade-off. **(A)** There was no difference between the blue and amber groups with regard to throughput performance on the zero-back task. **(B)** On the one-back task, the blue light group showed significantly enhanced throughput performance compared to the amber control group. **(C)** On the two-back task, there was a marginally significant trend toward greater throughput for the blue compared to the amber control group.

Table 3—Cluster maxima for whole brain exploratory analysis of blue > amber light conditions.

Region	Cluster Size	x	y	z	T	Cluster P (FWE corrected)
Right Middle Temporal Gyrus	262	60	−24	−6	5.41	0.007
Right Posterior Cingulate Gyrus	611	12	−46	26	5.00	< 0.001
Left Middle Occipital Gyrus	306	−36	−74	4	4.90	0.002
Right Inferior Frontal Gyrus/Insula	210	34	20	−6	4.83	0.009
Left Inferior Parietal Cortex	201	−44	−46	60	4.76	0.010
Left Inferior Frontal Gyrus	277	−44	34	−10	4.37	0.002
Brainstem/Thalamus	553	−4	−28	−8	4.13	< 0.001
Left Middle Temporal Gyrus	284	−54	−32	8	3.90	0.002

Exploratory whole brain analyses were conducted using a height threshold of P < 0.005 (uncorrected) and a cluster-extent correction of P < 0.05, family-wise error (FWE) corrected.

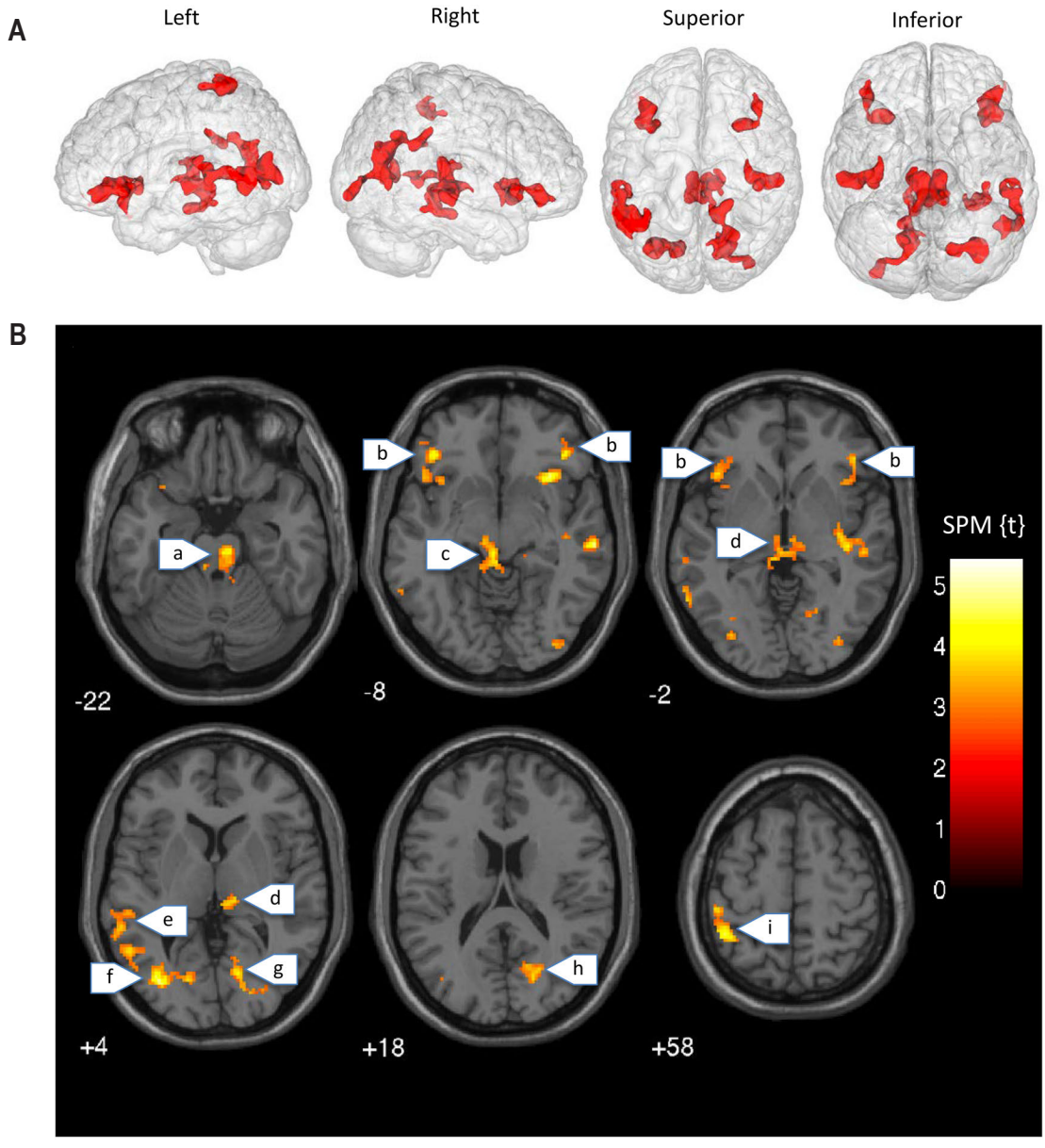

Figure 6—Whole brain exploratory analysis (height P < 0.005, cluster corrected P < 0.05, FWE). **(A)** The "glass brain" figures show the location of significant clusters of brain activation where Blue > Amber for the *N*-Back Task (two-back > zero-back). **(B)** The axial slices show the aforementioned clusters in greater anatomical detail. Blue light was associated with greater activation than amber control within: (a) pons, (b) inferior frontal gyrus, (c) superior brainstem, (d) thalamus, (e) middle temporal gyrus, (f) middle occipital gyrus, (g) lingual gyrus, (h) calcarine cortex, (i) inferior parietal lobule.

extent of the persisting effects of light on subsequent performance. It is conceivable that this prolonged effect may be a result of sustained noradrenergic activation. Prior research has shown that blue light exposure leads to greater activation within the LC, which in turn releases norepinephrine throughout the cortex.[13] If blue light exposure in our study promoted increased noradrenergic influence within the PFC (leading to an increase in baseline regional activation), this could plausibly explain the increased prefrontal BOLD responses and improved response times that we observed.

It is important to note that performance on the *N*-back task, in terms of faster response times, correlated positively with activation within the mid VLPFC. This finding is consistent with previous studies suggesting that an increase in baseline lateral prefrontal activation leads to faster decision-making.[31] Neurocomputational models suggest that the higher the baseline activity within a cortical area, the lower the activation needed to reach a response threshold, which can lead to faster response times.[18] This increase in baseline activation may in turn be explained by increased release of norepinephrine throughout the frontal cortex, due to stimulation of the LC[14] as a result of blue light exposure. It is also notable that blue light improved the speed of responses to the working memory task relative to amber control, but did not lead to an overall improvement in accuracy. Consideration of these data in light of the throughput metric, which quantifies the speed-accuracy tradeoff, suggests that while blue light was associated with an increase in the speed of responding to the working memory items, there was no corresponding loss of accuracy. Thus, blue light exposure was associated with the ability to make a greater number of correct responses per unit of time compared to the amber control light.

While previous studies that investigated the alerting effects of blue light have often employed study designs during nighttime,[5] or during prolonged (i.e., 4 hours) daytime exposure to blue light,[8] the present findings may have a broader application. Together with findings from previous studies, the results suggest that a relatively short duration (i.e., 30 minutes) of blue light exposure during the day can have a measurable effect on brain functioning and cognitive performance, not only acutely during the period of exposure, but that the effects may also endure for some time after termination of the light. This may have implications for the kind of light that is being used in office spaces, cockpits, and hospitals, in particular for individuals who have to perform their duties during sleep-deprived conditions. While the present study only examined the effects of light exposure under normally rested conditions, it is likely that these effects on brain activation and performance might be even more robust during periods of insufficient sleep. Prior work has suggested that blue wavelength light may be effective at improving some aspects of alertness and cognitive performance during nocturnal sleep loss,[32] but this has not been explored using neuroimaging techniques. It should also be pointed out that participants did not report any subjective differences in sleepiness/alertness depending on light condition. It is possible that longer light exposure is necessary to produce subjectively alerting effects of blue light exposure.

While the present findings suggest that blue wavelength light has meaningful effects on brain function and performance that persist beyond the exposure period, there are a number of limitations to be borne in mind. First, we present data on only a single cognitive task in a relatively artificial neuroimaging environment. Light exposure in the "real world" rarely follows these constraints. Further work with more ecologically valid tasks and environments will be necessary to establish the effectiveness of blue or blue-enriched white light in a variety of occupational settings. Some work has demonstrated increases in subjective alertness and performance after four weeks of blue-enriched white light exposure in offices,[9] but additional research will be necessary to determine the most effective parameters for administering light for the purpose of enhancing or sustaining performance in occupational settings. In addition, previous neuroimaging studies have employed an auditory, and not a visually presented letter variant of the *N*-back task as in the present study. It is unclear the extent to which the different variants of the *N*-back task might have contributed to some of the differences in findings across studies. It has been shown that an auditory *N*-back task may be more difficult than a visual variant of the *N*-back task. However, these differences in task type were only apparent at the three-back level.[33] The present study and previous fMRI studies investigating the effects of blue light on functional brain responses[15,19] have thus far been restricted to the two-back level. Nevertheless, future work that includes both visual and auditory *N*-back tasks that are more cognitively demanding will be necessary to establish whether blue wavelength light has a differential effect on these separate working memory systems. Furthermore, our sample sizes, while consistent with current practice in much of the neuroimaging literature, remain modest and limited in power, necessitating further replication to establish the reliability of the findings. Our sample was also relatively young and homogeneous in terms of background and health. Some evidence suggests that the effects of blue light on alertness may be attenuated among older individuals.[34] It has also been suggested that the effects of light on performance and brain responses may differ depending on genotype and circadian phase of testing.[35] Although participants were included if habitual bed and wake times fit within the pre-determined range to reduce variability due to circadian differences, the laboratory experiment started relatively early at 07:45 which may have led to elevated melatonin levels in some participants with later waking times. In addition, we did not collect genetic material in this sample, so examination of the role of genetics on the observed effects will require further study. Lastly, it should be pointed out that participants practiced the *N*-back task during either the blue light or amber light exposure (depending on condition). During the practice session participants received detailed instructions, were able to ask questions, and completed one trial of each condition (zero-back, one-back, and two-back) with feedback while undergoing light exposure. It is therefore possible that blue light exposure during the practice session influenced participants' ability to learn the task in such a way that they were able to perform better during the actual task. This potential role of light in learning is indeed an intriguing possibility. While the effects of blue light on immediate learning versus its persistent effects on subsequent performance cannot be disentangled here, this will likely be a fruitful question for further research.

CONCLUSIONS

The present findings suggest that daytime exposure to 30 minutes of blue wavelength light in non-sleep-deprived individuals has a beneficial impact on working memory performance and elicits measurable functional brain responses within prefrontal regions associated with executive functions. These results extend previous work by showing that exposure to blue light leads to persistent changes within the brain and performance during the post-exposure period (40 minutes). Additional research is necessary to identify the duration and breadth of these effects and how they may interact with individual difference factors such as gender, age, genotype, and other factors such as sleep debt and circadian influences.

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27. D'Esposito M, Postle BR, Rypma B. Prefrontal cortical contributions to working memory: evidence from event-related fMRI studies. Exp Brain Res 2000;133:3–11.
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32. Taillard J, Capelli A, Sagaspe P, Anund A, Akerstedt T, Philip P. In-car nocturnal blue light exposure improves motorway driving: a randomized controlled trial. PLoS One 2012;7:e46750.
33. Jaeggi SM, Buschkuehl M, Perrig WJ, Meier B. The concurrent validity of the N-back task as a working memory measure. Memory 2010;18:394–412.
34. Daneault V, Hebert M, Albouy G, et al. Aging reduces the stimulating effect of blue light on cognitive brain functions. Sleep 2014;37:85–96.
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SUBMISSION & CORRESPONDENCE INFORMATION

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PLACE AND DATE OF BIRTH Anchorage Alaska, September 2, 1965

CITIZENSHIP USA

CHRONOLOGY OF EDUCATION

8/83 - 5/85 A.A. (Liberal Arts), San Antonio College
8/83 - 5/85 A.A.S (Radio-TV-Film), San Antonio College
8/85 - 5/90 B.A. (Psychology), *Summa cum laude* with Distinction, University of New Mexico
8/90 - 5/92 M.A. (Clinical Psychology), Texas Tech University
8/92 - 8/96 Ph.D. (Clinical Psychology), Texas Tech University
Dissertation Title: *Development and validation of a new instrument for the measurement of transient mood states: The facial analogue mood scale (FAMS)*. Lubbock, TX: Texas Tech University;1995. Advisor: Bill Locke, Ph.D.

POST-DOCTORAL TRAINING

8/95 - 7/96 Predoctoral Fellow, Clinical Psychology, Yale School of Medicine
8/96 - 7/97 Postdoctoral Fellow, Clinical Neuropsychology, University of OK Health Sciences Center
8/97 - 7/99 Postdoctoral Fellow, Clinical Neuropsychology, University of Pennsylvania Medical School
7/99 - 9/00 Research Fellow, Neuroimaging, McLean Hospital/ Harvard Medical School
9/13 - 5/14 Certificate in Applied Biostatistics, Harvard Medical School

LICENSURE/CERTIFICATION

2001 - Licensed Psychologist, #966, State of New Hampshire

CHRONOLOGY OF EMPLOYMENT

Academic Appointments

10/00 - 8/02	Instructor in Psychology in the Department of Psychiatry Harvard Medical School, Boston, MA
9/02 - 7/07	Clinical Instructor in Psychology in the Department of Psychiatry Harvard Medical School, Boston, MA
8/07 - 10/10	Instructor in Psychology in the Department of Psychiatry Harvard Medical School, Boston, MA
4/08-	Faculty Affiliate, Division of Sleep Medicine Harvard Medical School, Boston, MA
10/10 - 10/12	Assistant Professor of Psychology in the Department of Psychiatry Harvard Medical School, Boston, MA
10/12 - 6/14	Associate Professor of Psychology in the Department of Psychiatry Harvard Medical School, Boston, MA
7/14-	Associate Professor of Psychology in the Department of Psychiatry (part-time) Harvard Medical School, Boston, MA
7/14-	Professor of Psychiatry—Tenured University of Arizona College of Medicine, Tucson, AZ
7/14-	Professor of Medical Imaging—Non TE University of Arizona College of Medicine, Tucson, AZ
9/14	Professor of Psychology—Non TE University of Arizona College of Science, Tucson, AZ

Hospital/Clinical/Institutional Appointments

10/00 - 8/02	Assistant Research Psychologist, McLean Hospital, Belmont, MA
8/02 - 7/04	Research Psychologist, Department of Behavioral Biology, Walter Reed Army Institute of Research, Silver Spring, MD
7/04 - 10/07	Chief, Neurocognitive Performance Branch, Walter Reed Army Institute of Research, Silver Spring, MD
10/07 - 3/10	Chief Psychologist, GovSource, Inc., U.S. Department of Defense (DoD) Contractor
8/08	Consulting Psychologist, The Brain Institute, University of Utah
9/02 - 4/05	Special Volunteer, National Institute on Deafness and Other Communication Disorders (NIDCD), National Institutes of Health (NIH), Bethesda, MD
9/02 - 7/07	Research Consultant, McLean Hospital, Belmont, MA
8/05 - 5/06	Neuropsychology Postdocotoral Research Program Training Supervisor, Walter Reed Hospital, Washington, DC
8/07 -	Research Psychologist, McLean Hospital, Belmont, MA
7/11 - 6/14	Director, Social Cognitive, and Affective Neuroscience (SCAN) Laboratory, McLean Hospital, Belmont, MA
7/14-	Director, Social, Cognitive, and Affective Neuroscience (SCAN) Laboratory, University of Arizona, Tucson, AZ

Military Positions

11/01 - 8/02	First Lieutenant, Medical Service Corps, United States Army Reserve (USAR)

8/02 - 7/05	Captain, Medical Service Corps, United States Army-Active Regular Army (RA)
8/05 - 10/07	Major, Medical Service Corps, United States Army-Active Regular Army (RA)
10/07 - 7/12	Major, Medical Service Corps, United States Army Reserve (USAR)
7/12 -	Lieutenant Colonel, Medical Service Corps, United States Army Reserve (USAR)

HONORS AND AWARDS

1990	Outstanding Senior Honors Thesis in Psychology, University of New Mexico
1990-1995	Maxey Scholarship in Psychology, Texas Tech University
2001	Rennick Research Award, Co-Author, International Neuropsychological Society
2002	Honor Graduate, AMEDD Officer Basic Course, U.S. Army Medical Department Center and School
2002	Lynch Leadership Award Nominee, AMEDD Officer Basic Course, U.S. Army Medical Department Center and School
2003	Outstanding Research Presentation Award, 2003 Force Health Protection Conference, U.S. Army Center for Health Promotion and Preventive Medicine
2003	Who's Who in America
2004	Who's Who in Medicine and Healthcare
2005	Edward L. Buescher Award for Excellence in Research by a Young Scientist, Walter Reed Army Institute of Research (WRAIR) Association
2009	Merit Poster Award, International Neuropsychological Society
2009	Outstanding Research Presentation Award, 2009 Force Health Protection Conference, U.S. Army Center for Health Promotion and Preventive Medicine
2010	Best Paper Award, Neuroscience, 27th U.S. Army Science Conference
2011	Published paper included in *Best of Sleep Medicine 2011*
2011	Blue Ribbon Finalist, 2011 Top Poster Award in Clinical and Translational Research, Society of Biological Psychiatry
2012	Defense Advance Research Projects Agency (DARPA) Young Faculty Award in Neuroscience
2014	Blue Ribbon Finalist, 2014 Top Poster Award in Basic Neuroscience, Society of Biological Psychiatry
2014	Harvard Medical School Excellence in Mentoring Award Nominee
2014	AASM Young Investigator Award (co-author), Honorable Mention, American Academy of Sleep Medicine

SERVICE/OUTREACH

Local/State Service/Outreach

2003	Scientific Review Committee, Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD
2005	Scientific Review Committee, Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD
2012-	McLean Hospital Research Committee, McLean Hospital, Belmont, MA

National/International Service/Outreach

2004	University of Alabama, Clinical Nutrition Research Center (UAB CNRC) Pilot/Feasibility Study Program Review Committee
2006	U.S. Small Business Administration, Small Business Technology Transfer (STTR) Program Review Committee
2006	Cognitive Performance Assessment Program Area Steering Committee, U.S. Army Military Operational Medicine Research Program Funding Panel
2007	Cognitive Performance Assessment Program Area Steering Committee, U.S. Army Military Operational Medicine Research Program Funding Panel
2008	United States Army Medical Research and Materiel Command (USAMRMC) Congressionally Directed Medical Research Programs (CDMRP) Extramural Grant Review Panel
2009	NIH-CSR Brain Disorders and Clinical Neuroscience N02 Member Study Conflict Section Review Panel
2009	Sleep Physiology and Fatigue Interventions Program Area Steering Committee, U.S. Army Military Operational Medicine Research Program
2009	Scotland, UK, Biomedical and Therapeutic Research Committee, Grant Reviewer
2010	Canada, Social Sciences and Humanities Research Council of Canada, Grant Reviewer
2011	National Science Foundation (NSF) Grant Reviewer
2011-	National Network of Depression Centers (NNDC), Military Task Group
2011	Israel, Israel Science Foundation (ISF), Grant Reviewer
2011	Scientific Review Committee, US Army Institute of Environmental Medicine (USARIEM)
2012	National Science Foundation (NSF) Grant Reviewer
2012-	American Academy of Sleep Medicine, Member
2013	Israel, Israel Science Foundation (ISF), Grant Reviewer
2014-	Organization for Human Brain Mapping, Member
2015-	Human Affectome Project Advisory Board Member

Departmental Committees

2006	Chair, Undergraduate Honors Thesis Committee, Jessica Richards, Department of Psychology, University of Maryland, Baltimore County, MD
2012-	Member, Research Committee, McLean Hospital, Belmont, MA
2014	Psychiatry Senior Research Manager Candidate Search Committee, Department of Psychiatry, University of Arizona, Tucson, AZ
2014-2015	Member, Faculty Search Committee, Department of Psychology, University of Arizona, Tucson, AZ.
2014-2016	Member, Comprehensive Examination Committee, Natalie Bryant, Department of Psychology, University of Arizona, Tucson, AZ
2014-2015	Chair/Research Faculty Mentor, Undergraduate Honors Thesis Committee, Haley Kent, Department of Biochemistry, University of Arizona, Tucson, AZ
2014-	Member, Psychiatry Research Investigator Committee, Department of Psychiatry, University of Arizona, Tucson, AZ.
2015	Member, Dissertation Committee, Ryan S. Smith, Ph.D., Department of Psychology, University of Arizona, Tucson AZ.
2015-	Member, Mentoring Committee, Department of Psychiatry, University of Arizona, Tucson, AZ
2016	Member, Dissertation Committee, Brian Arizmendi, Department of Psychology,

University of Arizona, Tucson, AZ

2016 Member, Masters Thesis Committee, Saren Seeley, Department of Psychology, University of Arizona, Tucson, AZ

2016 Member, Masters Thesis Committee, Mairead McConnell, Department of Psychology, University of Arizona, Tucson, AZ

2016 Faculty Advisor, Undergraduate Honor Thesis Committee, Matthew Nettles, Neuroscience/Cognitive Science, University of Arizona, Tucson, AZ

University Committees

2006 External Member, Doctoral Thesis Committee, Belinda J. Liddle, Ph.D., University of Sydney, Australia

2014 Ad Hoc Member, Interview Committee for Defense and Security Research Institute Director Position, University of Arizona, Tucson, AZ.

2014- Member, Mechanisms of Emotion, Social Relationships, and Health Interdisciplinary Developing Research Program, Clinical and Translational Science Institute, BIO5, University of Arizona, Tucson, AZ

2015 Vice President's Executive Committee for Defense and Security Strategic Planning, University of Arizona, Tucson, AZ

2015 Imaging Excellence Cluster Hire Search Committee, University of Arizona, Tucson, AZ

2015 MRI Operations Committee, University of Arizona, Tucson, AZ

2015-2016 Member, Neuroimaging Cluster Hire Faculty Search Committee, University of Arizona, Tucson, AZ

Editorial Board Membership

2009- Editorial Board Member, International Journal of Eating Disorders

2012- Editorial Board Member, Dataset Papers in Neuroscience

2012- Editorial Board Member, Dataset Papers in Psychiatry

2012- Editor, Journal of Sleep Disorders: Treatment and Care

Ad Hoc Journal Reviewer

2001-2012 Reviewer, Psychological Reports

2001-2012 Reviewer, Perceptual and Motor Skills

2002 Reviewer, American Journal of Psychiatry

2002-2013 Reviewer, Biological Psychiatry

2003 Reviewer, Clinical Neurology and Neurosurgery

2004-2016 Reviewer, NeuroImage

2004-2006 Reviewer, Neuropsychologia

2004-2016 Reviewer, Journal of Neuroscience

2004 Reviewer, Consciousness and Cognition

2005 Reviewer, Experimental Brain Research

2005 Reviewer, Schizophrenia Research

2005-2012 Reviewer, Archives of General Psychiatry

2005 Reviewer, Behavioral Brain Research

2005-2009 Reviewer, Human Brain Mapping

2005-2013 Reviewer, Psychiatry Research: Neuroimaging

2006	Reviewer, Journal of Abnormal Psychology
2006	Reviewer, Psychopharmacology
2006	Reviewer, Developmental Science
2006	Reviewer, Acta Psychologica
2006, 2015	Reviewer, Neuroscience Letters
2006-2016	Reviewer, Journal of Sleep Research
2006-2016	Reviewer, Physiology and Behavior
2006-2014	Reviewer, SLEEP
2007	Reviewer, Journal of Clinical and Experimental Neuropsychology
2008	Reviewer, European Journal of Child and Adolescent Psychiatry
2008	Reviewer, Judgment and Decision Making
2008-2010	Reviewer, Aviation, Space, & Environmental Medicine
2008	Reviewer, Journal of Psychophysiology
2008	Reviewer, Brazilian Journal of Medical and Biological Research
2008	Reviewer, The Harvard Undergraduate Research Journal
2008	Reviewer, Bipolar Disorders
2008-2013	Reviewer, Chronobiology International
2008	Reviewer, International Journal of Obesity
2009	Reviewer, European Journal of Neuroscience
2009-2015	Reviewer, International Journal of Eating Disorders
2009	Reviewer, Psychophysiology
2009	Reviewer, Traumatology
2009	Reviewer, Clinical Medicine: Therapeutics
2009	Reviewer, Acta Pharmacologica Sinica
2009	Reviewer, Collegium Antropologicum
2009	Reviewer, Journal of Psychopharmacology
2009-2014	Reviewer, Obesity
2009	Reviewer, Scientific Research and Essays
2009	Reviewer, Child Development Perspectives
2009-2010	Reviewer, Personality and Individual Differences
2009-2010	Reviewer, Noise and Health
2009-2010	Reviewer, Sleep Medicine
2010	Reviewer, Nature and Science of Sleep
2010	Reviewer, Psychiatry and Clinical Neurosciences
2010	Reviewer, Learning and Individual Differences
2010	Reviewer, Cognitive, Affective, and Behavioral Neuroscience
2010	Reviewer, BMC Medical Research Methodology
2010-2011	Reviewer, Journal of Adolescence
2010-2012	Reviewer, Brain Research
2011	Reviewer, Brain
2011	Reviewer, Social Cognitive and Affective Neuroscience
2011	Reviewer, Journal of Traumatic Stress
2011	Reviewer, Social Neuroscience
2011-2014	Reviewer, Brain and Cognition
2011	Reviewer, Frontiers in Neuroscience
2011-2012	Reviewer, Sleep Medicine Reviews
2012	Reviewer, Journal of Experimental Psychology: General
2012	Reviewer, Ergonomics

2012 Reviewer, Behavioral Sleep Medicine
2012 Reviewer, Neuropsychology
2012 Reviewer, Emotion
2012 Reviewer, JAMA
2012 Reviewer, BMC Neuroscience
2012-2015 Reviewer, Cognition and Emotion
2012 Reviewer, Journal of Behavioral Decision Making
2012 Reviewer, Psychosomatic Medicine
2012-2014 Reviewer, PLoS One
2012 Reviewer, American Journal of Critical Care
2012-2014 Reviewer, Journal of Sleep Disorders: Treatment and Care
2013 Reviewer, Experimental Psychology
2013 Reviewer, Clinical Interventions in Aging
2013 Reviewer, Frontiers in Psychology
2013 Reviewer, Brain Structure and Function
2013 Reviewer, Appetite
2013-2016 Reviewer, JAMA Psychiatry
2014 Reviewer, Acta Psychologica
2014 Reviewer, Neurology
2014 Reviewer, Applied Neuropsychology: Child
2014-2016 Reviewer, Journal of Applied Psychology
2015 Reviewer, Early Childhood Research Quarterly
2015 Reviewer, Behavioral Neuroscience
2015 Reviewer, Scientific Reports
2016 Reviewer, Neuroscience & Biobehavioral Reviews
2016 Reviewer, Psychological Science
2016 Reviewer, Medicine & Science in Sports and Exercise
2016 Reviewer, Archives of Clinical Neuropsychology

PUBLICATIONS/CREATIVE ACTIVITY

Refereed Journal Articles

1. **Killgore WD**. The Affect Grid: a moderately valid, nonspecific measure of pleasure and arousal. Psychol Rep. 83(2):639-42, 1998.

2. **Killgore WD**. Empirically derived factor indices for the Beck Depression Inventory. Psychol Rep. 84(3 Pt 1):1005-13, 1999.

3. **Killgore WD**. Affective valence and arousal in self-rated depression and anxiety. Percept Mot Skills. 89(1):301-4, 1999.

4. **Killgore WD**, Adams RL. Prediction of Boston Naming Test performance from vocabulary scores: preliminary guidelines for interpretation. Percept Mot Skills. 89(1):327-37, 1999.

5. **Killgore WD**, Gangestad SW. Sex differences in asymmetrically perceiving the intensity of facial expressions. Percept Mot Skills. 89(1):311-4, 1999.

6. **Killgore WD**. The visual analogue mood scale: can a single-item scale accurately classify depressive mood state? Psychol Rep. 85(3 Pt 2):1238-43, 1999.

7. **Killgore WD**, DellaPietra L, Casasanto DJ. Hemispheric laterality and self-rated personality traits. Percept Mot Skills. 89(3 Pt 1):994-6, 1999.

8. **Killgore WD**, Glosser G, Casasanto DJ, French JA, Alsop DC, Detre JA. Functional MRI and the Wada test provide complementary information for predicting post-operative seizure control. Seizure. 8(8):450-5, 1999.

9. **Killgore WD**. Evidence for a third factor on the Positive and Negative Affect Schedule in a college student sample. Percept Mot Skills. 90(1):147-52, 2000.

10. **Killgore WD**, Dellapietra L. Item response biases on the logical memory delayed recognition subtest of the Wechsler Memory Scale-III. Psychol Rep. 86(3 Pt 1):851-7, 2000.

11. **Killgore WD**, Casasanto DJ, Yurgelun-Todd DA, Maldjian JA, Detre JA. Functional activation of the left amygdala and hippocampus during associative encoding. Neuroreport. 11(10):2259-63, 2000.

12. Yurgelun-Todd DA, Gruber SA, Kanayama G, **Killgore WD**, Baird AA, Young AD. fMRI during affect discrimination in bipolar affective disorder. Bipolar Disord. 2(3 Pt 2):237-48, 2000.

13. **Killgore WD**. Sex differences in identifying the facial affect of normal and mirror-reversed faces. Percept Mot Skills. 91(2):525-30, 2000.

14. **Killgore WD**, DellaPietra L. Using the WMS-III to detect malingering: empirical validation of the rarely missed index (RMI). J Clin Exp Neuropsychol. 22(6):761-71, 2000.

15. **Killgore WD**. Academic and research interest in several approaches to psychotherapy: a computerized search of literature in the past 16 years. Psychol Rep. 87(3 Pt 1):717-20, 2000.

16. Maldjian JA, Detre JA, **Killgore WD**, Judy K, Alsop D, Grossman M, Glosser G. Neuropsychologic performance after resection of an activation cluster involved in cognitive memory function. AJR Am J Roentgenol. 176(2):541-4, 2001.

17. **Killgore WD**, Oki M, Yurgelun-Todd DA. Sex-specific developmental changes in amygdala responses to affective faces. Neuroreport. 12(2):427-33, 2001.

18. **Killgore WD**, Yurgelun-Todd DA. Sex differences in amygdala activation during the perception of facial affect. Neuroreport. 12(11):2543-7, 2001.

19. Casasanto DJ, **Killgore WD**, Maldjian JA, Glosser G, Alsop DC, Cooke AM, Grossman M, Detre JA. Neural correlates of successful and unsuccessful verbal memory encoding. Brain Lang. 80(3):287-95, 2002.

20. **Killgore WD**. Laterality of lesions and trait-anxiety on working memory performance. Percept Mot Skills. 94(2):551-8, 2002.

21. **Killgore WD**, Cupp DW. Mood and sex of participant in perception of happy faces. Percept Mot Skills. 95(1):279-88, 2002.

22. Yurgelun-Todd DA, **Killgore WD**, Young AD. Sex differences in cerebral tissue volume and cognitive performance during adolescence. Psychol Rep. 91(3 Pt 1):743-57, 2002.

23. Yurgelun-Todd DA, **Killgore WD**, Cintron CB. Cognitive correlates of medial temporal lobe development across adolescence: a magnetic resonance imaging study. Percept Mot Skills. 96(1):3-17, 2003.

24. **Killgore WD**, Young AD, Femia LA, Bogorodzki P, Rogowska J, Yurgelun-Todd DA. Cortical and limbic activation during viewing of high- versus low-calorie foods. Neuroimage. 19(4):1381-94, 2003.

25. **Killgore WD**, Yurgelun-Todd DA. Activation of the amygdala and anterior cingulate during nonconscious processing of sad versus happy faces. Neuroimage. 21(4):1215-23, 2004.

26. **Killgore WD**, Yurgelun-Todd DA. Sex-related developmental differences in the lateralized activation of the prefrontal cortex and amygdala during perception of facial affect. Percept Mot Skills. 99(2):371-91, 2004.

27. **Killgore WD**, Glahn DC, Casasanto DJ. Development and Validation of the Design Organization Test (DOT): a rapid screening instrument for assessing visuospatial ability. J Clin Exp Neuropsychol. 27(4):449-59, 2005.

28. **Killgore WD**, Yurgelun-Todd DA. Body mass predicts orbitofrontal activity during visual presentations of high-calorie foods. Neuroreport. 16(8):859-63, 2005.

29. Wesensten NJ, **Killgore WD**, Balkin TJ. Performance and alertness effects of caffeine, dextroamphetamine, and modafinil during sleep deprivation. J Sleep Res. 14(3):255-66, 2005.

30. **Killgore WD**, Yurgelun-Todd DA. Social anxiety predicts amygdala activation in adolescents viewing fearful faces. Neuroreport. 16(15):1671-5, 2005.

31. **Killgore WD**, Yurgelun-Todd DA. Developmental changes in the functional brain responses of adolescents to images of high and low-calorie foods. Dev Psychobiol. 47(4):377-97, 2005.

32. Kahn-Greene ET, Lipizzi EL, Conrad AK, Kamimori GH, **Killgore WD**. Sleep deprivation adversely affects interpersonal responses to frustration. Pers Individ Dif. 41(8):1433-1443, 2006.

33. McBride SA, Balkin TJ, Kamimori GH, **Killgore WD**. Olfactory decrements as a function of two nights of sleep deprivation. J Sens Stud. 24(4):456-63, 2006.

34. **Killgore WD**, Yurgelun-Todd DA. Ventromedial prefrontal activity correlates with depressed mood in adolescent children. Neuroreport. 17(2):167-71, 2006.

35. **Killgore WD**, Vo AH, Castro CA, Hoge CW. Assessing risk propensity in American soldiers: preliminary reliability and validity of the Evaluation of Risks (EVAR) scale--English version. Mil Med. 171(3):233-9, 2006.

36. **Killgore WD**, Balkin TJ, Wesensten NJ. Impaired decision making following 49 h of sleep deprivation. J Sleep Res. 15(1):7-13, 2006.

37. **Killgore WD**, Stetz MC, Castro CA, Hoge CW. The effects of prior combat experience on the expression of somatic and affective symptoms in deploying soldiers. J Psychosom Res. 60(4):379-85, 2006.

38. **Killgore WD**, McBride SA, Killgore DB, Balkin TJ. The effects of caffeine, dextroamphetamine, and modafinil on humor appreciation during sleep deprivation. Sleep. 29(6):841-7, 2006.

39. **Killgore WD**, McBride SA. Odor identification accuracy declines following 24 h of sleep deprivation. J Sleep Res. 15(2):111-6, 2006.

40. **Killgore WD**, Yurgelun-Todd DA. Affect modulates appetite-related brain activity to images of food. Int J Eat Disord. 39(5):357-63, 2006.

41. Kendall AP, Kautz MA, Russo MB, **Killgore WD**. Effects of sleep deprivation on lateral visual attention. Int J Neurosci. 116(10):1125-38, 2006.

42. Yurgelun-Todd DA, **Killgore WD**. Fear-related activity in the prefrontal cortex increases with age during adolescence: a preliminary fMRI study. Neurosci Lett. 406(3):194-9, 2006.

43. **Killgore WD**, Killgore DB, Ganesan G, Krugler AL, Kamimori GH. Trait-anger enhances effects of caffeine on psychomotor vigilance performance. Percept Mot Skills. 103(3):883-6, 2006.

44. **Killgore WD**, Yurgelun-Todd DA. Unconscious processing of facial affect in children and adolescents. Soc Neurosci. 2(1):28-47, 2007.

45. **Killgore WD**, Yurgelun-Todd DA. The right-hemisphere and valence hypotheses: could they both be right (and sometimes left)?. Soc Cogn Affect Neurosci. 2(3):240-50, 2007.

46. **Killgore WD**, Killgore DB. Morningness-eveningness correlates with verbal ability in women but not men. Percept Mot Skills. 104(1):335-8, 2007.

47. **Killgore WD**, Killgore DB, Day LM, Li C, Kamimori GH, Balkin TJ. The effects of 53 hours of sleep deprivation on moral judgment. Sleep. 30(3):345-52, 2007.

48. Rosso IM, **Killgore WD**, Cintron CM, Gruber SA, Tohen M, Yurgelun-Todd DA. Reduced amygdala volumes in first-episode bipolar disorder and correlation with cerebral white matter. Biol Psychiatry. 61(6):743-9, 2007.

49. Kahn-Greene ET, Killgore DB, Kamimori GH, Balkin TJ, **Killgore WD**. The effects of sleep deprivation on symptoms of psychopathology in healthy adults. Sleep Med. 8(3):215-21, 2007.

50. **Killgore WD**. Effects of sleep deprivation and morningness-eveningness traits on risk-taking. Psychol Rep. 100(2):613-26, 2007.

51. **Killgore WD**, Gruber SA, Yurgelun-Todd DA. Depressed mood and lateralized prefrontal activity during a Stroop task in adolescent children. Neurosci Lett. 416(1):43-8, 2007.

52. **Killgore WD**, Yurgelun-Todd DA. Positive affect modulates activity in the visual cortex to images of high calorie foods. Int J Neurosci. 117(5):643-53, 2007.

53. Vo AH, Satori R, Jabbari B, Green J, **Killgore WD**, Labutta R, Campbell WW. Botulinum toxin type-a in the prevention of migraine: a double-blind controlled trial. Aviat Space Environ Med. 78(5 Suppl):B113-8, 2007.

54. **Killgore WD**, Yurgelun-Todd DA. Neural correlates of emotional intelligence in adolescent children. Cogn Affect Behav Neurosci. 7(2):140-51, 2007.

55. **Killgore WD**, Kendall AP, Richards JM, McBride SA. Lack of degradation in visuospatial perception of line orientation after one night of sleep loss. Percept Mot Skills. 105(1):276-86, 2007.

56. **Killgore WD**, Lipizzi EL, Kamimori GH, Balkin TJ. Caffeine effects on risky decision making after 75 hours of sleep deprivation. Aviat Space Environ Med. 78(10):957-62, 2007.

57. **Killgore WD**, Richards JM, Killgore DB, Kamimori GH, Balkin TJ. The trait of Introversion-Extraversion predicts vulnerability to sleep deprivation. J Sleep Res. 16(4):354-63, 2007.

58. **Killgore WD**, Kahn-Green ET, Killgore DB, Kamimori GH, Balkin TJ. Effects of acute caffeine withdrawal on Short Category Test performance in sleep-deprived individuals. Percept Mot Skills. 105(3 pt.2):1265-74, 2007.

59. **Killgore WD**, Killgore DB, McBride SA, Kamimori GH, Balkin TJ. Odor identification ability predicts changes in symptoms of psychopathology following 56 hours of sleep deprivation. J Sensory Stud. 23(1):35-51, 2008.

60. **Killgore WD**, Rupp TL, Grugle NL, Reichardt RM, Lipizzi EL, Balkin TJ. Effects of dextroamphetamine, caffeine and modafinil on psychomotor vigilance test performance after 44 h of continuous wakefulness. J Sleep Res. 17(3):309-21, 2008.

61. Huck NO, McBride SA, Kendall AP, Grugle NL, **Killgore WD**. The effects of modafinil, caffeine, and dextroamphetamine on judgments of simple versus complex emotional expressions following sleep deprivation. Int. J Neuroscience. 118(4):487-502, 2008.

62. **Killgore WD**, Kahn-Greene ET, Lipizzi EL, Newman RA, Kamimori GH, Balkin TJ. Sleep deprivation reduces perceived emotional intelligence and constructive thinking skills. Sleep Med. 9(5):517-26, 2008.

63. **Killgore WD**, Grugle NL, Killgore DB, Leavitt BP, Watlington GI, McNair S, Balkin TJ. Restoration of risk-propensity during sleep deprivation: caffeine, dextroamphetamine, and modafinil. Aviat Space Environ Med. 79(9):867-74, 2008.

64. **Killgore WD**, Muckle AE, Grugle NL, Killgore DB, Balkin TJ. Sex differences in cognitive estimation during sleep deprivation: effects of stimulant countermeasures. Int J Neurosci. 118(11):1547-57, 2008.

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81. Britton, JC, Stewart, SE, **Killgore, WD**, Rosso, IM, Price, LM, Gold, AL, Pine, DS, Wilhelm, S, Jenike, MA, & Rauch, SL. Amygdala activation in response to facial expressions in pediatric obsessive-compulsive disorder. Depress Anxiety, 27: 643-651, 2010.

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88. Gruber, SA, Dahlgren, MK, Sagar, KA, Gonenc, A, & **Killgore, WD.** Age of onset of marijuana use impacts inhibitory processing. Neurosci Lett 511(2):89-94, 2012.

89. **Killgore, WD**, Capaldi, VF, & Guerrero, ML. Nocturnal polysomnographic correlates of daytime sleepiness. Psychol Rep, 110(10), 63-72, 2012.

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113. Webb, CA, DelDonno, S, & **Killgore, WD**. The role of cognitive versus emotional intelligence in Iowa Gambling Task performance: What's emotion got to do with it? Intelligence, 44, 112-119,

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120. Alkozei, A, & **Killgore WD**. Emotional intelligence is associated with reduced insula responses to angry faces. NeuroReport, 26, 567-571, 2015.

121. Mundy, EA, Weber, M, Rauch, SL, **Killgore, WD**, Simon, NM, Pollack, MH, & Rosso, IM. Adult anxiety disorders in relation to trait anxiety and perceived stress in childhood. Psychological Reports, 117, 1-17, 2015.

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123. Olson, EA, Rosso, IM, Demers, LA, Divatia, S., & **Killgore, WD**. Sex differences in psychological factors associated with social discounting. Journal of Behavioral Decision Making, 29, 60-66, 2016.

124. Alkozei, A, Schwab, ZJ, & **Killgore, WD**. The role of emotional intelligence during an emotionally difficult decision-making task. Journal of Nonverbal Behavior, 40, 39-54, 2016.

125. **Killgore, WD**, Singh, P, Kipman, M, Pisner, D, Fridman, A, and Weber, M. Gray matter volume and executive functioning correlate with time since injury following mild traumatic brain injury. Neuroscience Letters, 612, 238-244, 2016.

126. Alkozei, A, Smith, R, & **Killgore, WD**. Exposure to blue wavelength light modulates anterior cingulate cortex activation in response to 'uncertain' versus 'certain' anticipation of positive stimuli. Neuroscience Letters, 616, 5-10, 2016.

127. Olson, EA, Weber, M, Rauch, SL, & **Killgore, WD**. Daytime sleepiness is associated with reduced integration of temporally distant outcomes on the Iowa Gambling Task. Behavioral Sleep Medicine, 14, 200-211, 2016.

128. **Killgore, WD**, Sonis, LA, Rosso, IM, & Rauch, SL. Emotional intelligence partially mediates the association between anxiety sensitivity and anxiety symptoms. Psychological Reports, 118, 23-40, 2016.

129. Freed, MC, Novak, LA, **Killgore, WD**, Rauch, S, Koehlmoos, TP, Ginsberg, JP, Krupnick, J, Rizzo, AS, Andrews, A, & Engle, CC. IRB and research regulatory delays within the military healthcare setting: Do they really matter? And if so, why and for whom? American Journal of Bioethics, 16, 30-37, 2016.

130. Alkozei, A, Smith, R, Pisner, D, Vanuk, JR, Markowski, SM, Fridman, A, Shane, BR, Knight, SA, & **Killgore, WD**. Exposure to blue light increases later functional activation of the prefrontal cortex during working memory. SLEEP, 3, 1671-1680, 2016.

131. Smith, R, Alkozei, A, Lane, RD, & **Killgore, WD**. Unwanted reminders: The effects of emotional memory suppression on subsequent neuro-cognitive processing. Consciousness and Cognition, 44, 103-113, 2016.

132. Smith, R, Alkozei, A, & **Killgore, WD**. Contributions of self-report and performance-based individual differences measures of social cognitive ability on large-scale network functioning. Brain Imaging and Behavior (in press).

133. Pisner, DA, Smith, R, Alkozei, A, Klimova, A, & **Killgore, WD**. Highways of the emotional intellect: White matter microstructural correlates of an ability-based measure of emotional intelligence. Social Neuroscience (in press).

134. Kelly, MR, **Killgore, WD**, Haynes, PL. Understanding recent insights in sleep and posttraumatic stress disorder from a research domain criteria (RDoC) framework. Current Sleep Medicine Reports (in press).

Book Chapters/Editorials

1. **Killgore, WD.** Cortical and limbic activation during visual perception of food. In Dube, L, Bechara, A, Dagher, A, Drewnowski, A, Lebel, J, James, P, & Yada, R. (Eds), Obesity Prevention: The Role of Brain and Society on Individual Behavior. Elsevier, Boston, 2010, pp. 57-71.

2. **Killgore, WD.** Asleep at the trigger: Warfighter judgment and decision-making during prolonged wakefulness. In Bartone, P. (Ed), Applying Research Psychology to Improve Performance and Policy. 2010, pp. 59-77.

3. **Killgore, WD.** Effects of Sleep Deprivation on Cognition. In Kerkhof, G. & Van Dongen, H. Progress in Brain Research: Sleep and Cognition. Elsevier, B.V. New York, 2010, pp. 105-129.

4. **Killgore, WD.** Caffeine and other alerting agents. In Thorpy, M. & Billiard, M. (Eds), Sleepiness: Causes, Consequences, Disorders and Treatment. Cambridge University Press, UK, 2011, pp. 430-443.

5. **Killgore WD.** Priorities and challenges for caffeine research: Energy drinks, PTSD, and withdrawal reversal. The Experts Speak Column, J Caffeine Res, 1, 11-12, 2011.

6. **Killgore, WD.** Odor identification ability predicts executive function deficits following sleep deprivation. In Lee-Chiong, T (Ed), Best of Sleep Medicine 2011. National Jewish Health, Denver CO, 2011, pp. 31-33.

7. **Killgore, WD.** Socio-emotional and neurocognitive effects of sleep loss. In Matthews, G. (Ed), Handbook of Operator Fatigue. Ashgate, London UK, 2012, pp. 227-243.

8. **Killgore, WD.** Sleepless nights and bulging waistlines (Editorial). Journal of Sleep Disorders: Treatment and Care, 1(1), doi: 10.4172/jsdtc.1000e101, 2012.

9. **Killgore, WD**, & Penetar, DM. Sleep and Military Operational Effectiveness. In Kushida, CA (Ed), The Encyclopedia of Sleep, 2013, vol. 1, pp. 311-319. Academic Press, Waltham, MA.

10. **Killgore, WD**, Weiner, MR, & Schwab, ZJ. Sleep deprivation, personality, and psychopathic changes. In Kushida, CA (Ed), The Encyclopedia of Sleep, 2013, vol. 1, pp. 264-271. Academic Press, Waltham, MA.

11. Schoenberg, MR, & **Killgore, WD**. Psychologic and Psychiatric Assessment. In Kushida, CA (Ed), The Encyclopedia of Sleep, 2013, vol. 2, pp. 23-26. Academic Press, Waltham, MA.

12. **Killgore, WD.** Sleep loss and performance. In Moore, BA, & Barnett, JE (Eds), Military Psychologists' Desk Reference, 2013, pp. 241-246. Oxford University Press, New York.

13. Weber, M., & **Killgore, WD**. What are the emerging therapeutic uses of bright light therapy for neurological disorders? (Editorial). Future Neurology, 8, 495-497, 2013.

14. **Killgore WD** & Weber, M. Sleep deprivation and cognitive performance. In Bianchi, M (Ed), Sleep Deprivation and Disease: Effects on the Body, Brain and Behavior, 2014, pp. 209-229. Springer, New York.

15. **Killgore, WD**. Sleep deprivation and behavioral risk taking. In Watson, RR, Sleep Modulation by Obesity, Diabetes, Age and Diet, 2015, pp. 279-287. Elsevier, San Diego, CA.

16. **Killgore, WD**. Lighting the way to better sleep and health (Editorial). Journal of Sleep Disorders: Treatment and Care, 5:1.

17. Klimova, A, Singh, P, & **Killgore WD**. White matter abnormalities in MS: Advances in diffusion tensor imaging/tractography. In Watson, RR & Killgore, WD (Eds), Nutrition and Lifestyle in Neurological Autoimmune Diseases (in press).

18. Singh, P, & **Killgore WD**. Time dependent differences in gray matter volume post mild traumatic brain injury. Neural Regeneration Research, 11, 920-921, 2016.

Published U.S. Government Technical Reports

1. **Killgore, WD**, Estrada, A, Rouse, T, Wildzunas, RM, Balkin, TJ. Sleep and performance measures in soldiers undergoing military relevant training. USAARL Report No. 2009-13. June, 2009.

2. Kelley, AM, **Killgore, WD**, Athy, JR, Dretsch, M. Risk propensity, risk perception, and sensation seeking in U.S. Army Soldiers: A preliminary study of a risk assessment battery. USAARL Report No. 2010-02. DTIC #: ADA511524. October, 2009.

WORKS IN PROGRESS

1. **Killgore, WD**, Olson, EA, Weber, M, Rauch, SL, & Nickerson, LD. Emotional intelligence is associated with synchronized resting state activity between emotion regulation and interoceptive experience networks. NeuroImage (submitted).

2. Smith, R, **Killgore, WD**, & Lane, RD. A reconceptualization of emotional intelligence based on neural systems. Behavioral and Brain Sciences (submitted).

3. Alkozei, A, & **Killgore, WD**. Gratitude and wellbeing: A review and proposed model. Journal of Happiness Studies (submitted).

4. **Killgore, WD**. Individual differences in rested activation of the ventral striatum predicts overeating during sleep deprivation. (in preparation).

5. **Killgore, WD**, Tkachenko, O, Rauch, SL, & Nickerson, LD. Multimodal neuroimaging at rested baseline predicts resistance to overnight sleep deprivation. (in preparation).

6. Chaumet, G, **Killgore WD**, & Rabat, A. Performance self-estimation and decision-making: an new task (GoPT) for exploring aspects of risk taking. (in preparation).

7. Pisner, DA, Smith, R, Alkozei, A, Klimova, A, & **Killgore, WD**. White matter microstructural correlates of an ability measure of emotional intelligence. (in preparation).

8. Sneider, JT, Jensen, JE, Silveri, MM, & **Killgore, WD**. Prefrontal GABA predicts resistance to

sleep deprivation. (in preparation).

9. Weber, M, **Killgore WD**, and Rauch, SL. Regionally specific alterations in network organization following psychological trauma and post-traumatic stress disorder. (in preparation).

10. Weber, M, & **Killgore, WD**. Functional brain network organization in relation to self-reported habitual sleep. (in preparation).

11. Weber, M, & **Killgore WD**. Sleep disturbance following traumatic brain injury—a critical review. (in preparation).

12. **Killgore, WD**. Neural correlates of healthy food and activity decisions. (in preparation).

CONFERENCES/SCHOLARLY PRESENTATIONS

Colloquia

2000 *The Neurobiology of Emotion in Children*, McLean Hospital, Belmont, MA *[Invited Lecture]*

2001 *The Neurobiology of Emotion in Children and Adolescents*, McLean Hospital, Belmont, MA *[Invited Lecture]*

2002 Cortico-Limbic Activation in Adolescence and Adulthood, Youth Advocacy Project, Cape Cod, MA [Invited Lecture]

2008 Lecture on *Sleep Deprivation, Executive Function, and Resilience to Sleep Loss*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2008 Lecture on *The Role of Research Psychology in the Army*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2008 Lecture on *Combat Stress Control: Basic Battlemind Training*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2009 Lecture entitled *Evaluate a Casualty, Prevent Shock, and Prevent Cold Weather injuries*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA*[Invited Lecture]*

2009 Lecture on *Combat Exposure and Sleep Deprivation Effects on Risky Decision-Making*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2009 Lecture on the *Sleep History and Readiness Predictor (SHARP)*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2009 Lecture on *The Use of Actigraphy for Measuring Sleep in Combat and Military Training*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2010 Lecture entitled *Casualty Evaluation*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2010 Lecture entitled *Combat Stress and Risk-Taking Behavior Following Deployment*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2010 Lecture entitled *Historical Perspectives on Combat Medicine at the Battle of Gettysburg*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2010 Lecture entitled *Sleep Loss, Stimulants, and Decision-Making*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2010 Lecture entitled *PTSD: New Insights from Brain Imaging*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2011 Lecture entitled *Effects of bright light therapy on sleep, cognition and brain function after mild traumatic brain injury*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2011 Lecture entitled *Laboratory Sciences and Research Psychology in the Army*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2011 Lecture entitled *Tools for Assessing Sleep in Military Settings*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2011 Lecture entitled *The Brain Basis of Emotional Trauma and Practical Issues in Supporting Victims of Trauma*, U.S. Department of Justice, United States Attorneys Office, Serving Victims of Crime Training Program, Holyoke, MA *[Invited Lecture]*

2011 Lecture entitled *The Brain Altering Effects of Traumatic Experiences*; 105th Reinforcement Training Unit (RTU), U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2012 Lecture entitled *Sleep Loss, Caffeine, and Military Performance*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2012 Lecture entitled *Using Light Therapy to Treat Sleep Disturbance Following Concussion*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2013 Lecture entitled *Brain Responses to Food: What you See Could Make you Fat*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2013 Lecture entitled *Predicting Resilience Against Sleep Loss*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2014 Lecture entitled *Get Some Shut-Eye or Get Fat: Sleep Loss Affects Brain Responses to Food*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2014 Lecture entitled *Emotional Intelligence: Developing a Training Program*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2014 Lecture entitled *Supporting Cognitive and Emotional Health in Warfighters*. Presented to the Senior Vice President for the Senior Vice President for Health Sciences and Dean of the Medical School, University of Arizona, Tucson, AZ *[Invited Lecture]*

2015 Lecture entitled *Understanding the Effects of Mild TBI (Concussion) on the Brain*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2015 Presentation entitled Superhuman Brains: The Neurocircuitry that Underlies the Ability to Resist Sleep Deprivation. Presented at the Neuroscience Datablitz, University of Arizona, Tucson, AZ *[Invited Lecture]*

2015 Presentation entitled: SCAN Lab Traumatic Stress Study. Presented at the Tucson Veteran Center, Tucson AZ *[Invited Lecture]*

2016 Presentation entitled: SCAN Lab Overview. Presented at the University of Arizona 2016 Sleep workshop, Tucson, AZ *[Invited Lecture]*

2016 Lecture entitled *Trauma Exposure and the Brain*; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

2016 Presentation entitled *Supporting Cognitive and Emotional Health in Warfighters*. UAHS Development Team, University of Arizona Health Sciences Center, Tucson, AZ *[Invited Lecture]*

2016 Lecture entitled Novel Approaches for Reducing Depression in the Military; 105th IMA Detachment, U.S. Army Reserve Center, Boston, MA *[Invited Lecture]*

Seminars

2001 *Using Functional MRI to Study the Developing Brain*, Judge Baker Children's Center, Harvard Medical School, Boston, MA *[Invited Lecture]*

2002 Lecture on the *Changes in the Lateralized Structure and Function of the Brain during Adolescent Development*, Walter Reed Army Institute of Research, Washington, DC *[Invited Lecture]*

2005 Lecture on *Functional Neuroimaging, Cognitive Assessment, and the Enhancement of Soldier Performance*, Walter Reed Army Institute of Research, Washington, DC *[Invited Lecture]*

2005 Lecture on *The Sleep History and Readiness Predictor*: Presented to the Medical Research and Materiel Command, Ft. Detrick, MD *[Invited Lecture]*

2006 Lecture on *Optimization of Judgment and Decision Making Capacities in Soldiers Following Sleep Deprivation*, Brain Imaging Center, McLean Hospital, Belmont MA *[Invited Lecture]*

2006 Briefing to the Chairman of the Cognitive Performance Assessment Program Area Steering Committee, U.S. Army Military Operational Medicine Research Program, entitled *Optimization of Judgment and Decision Making Capacities in Soldiers Following Sleep Deprivation*, Walter Reed Army Institute of Research *[Invited Lecture]*

2010 Lecture on *Patterns of Cortico-Limbic Activation Across Anxiety Disorders*, Center for Anxiety, Depression, and Stress, McLean Hospital, Belmont, MA *[Invited Lecture]*

2010 Lecture on *Cortico-Limbic Activation Among Anxiety Disorders*, Neuroimaging Center, McLean Hospital, Belmont, MA *[Invited Lecture]*

2011 Lecture on *Shared and Differential Patterns of Cortico-Limbic Activation Across Anxiety Disorders*, McLean Research Day Brief Communications, McLean Hospital, Belmont, MA *[Invited Lecture]*

2014 Lecture entitled *Supporting Cognitive and Emotional Health in Warfighters*. Presented to the Senior Vice President for t for Health Sciences and Dean of the Medical School, University of Arizona, Tucson, AZ *[Invited Lecture]*

2015 Lecture entitled *Sleep Loss and Brain Responses to Food*. Presented for the Sleep Medicine Lecture Series, University of Arizona Medical Center, Tucson, AZ *[Invited Lecture]*

2015 Presentation entitled *Superhuman Brains: The Neurocircuitry that Underlies the Ability to Resist Sleep Deprivation*. Presented at the Neuroscience Datablitz, University of Arizona, Tucson, AZ *[Invited Lecture]*

2015 Lecture entitled *Sleep Deprivation Selectively Impairs Emotional Aspects of Cognition*. Presented at the Pamela Turbeville Speaker Series, McClelland Institute for Children, Youth, and Families, Tucson, AZ, *[Invited Lecture]*

2005 Briefing to the Chairman of the National Research Council (NRC) Committee on Strategies to Protect the Health of Deployed U.S. Forces, John H. Moxley III, on the *Optimization of Judgment and Decision Making Capacities in Soldiers Following Sleep Deprivation*, Walter Reed Army Institute of Research, Washington, DC *[Invited Lecture]*

2006 Lecture on *Norming a Battery of Tasks to Measure the Cognitive Effects of Operationally Relevant Stressors*, Cognitive Performance Assessment Program Area Steering Committee, U.S. Army Military Operational Medicine Research Program, Washington, DC *[Invited Lecture]*

2007 Lecture on *Cerebral Responses During Visual Processing of Food*, U.S. Army Institute of Environmental Medicine, Natick, MA *[Invited Lecture]*

2007 Briefing on the *Measurement of Sleep-Wake Cycles and Cognitive Performance in Combat Aviators*, U.S. Department of Defense, Defense Advanced Research Projects Agency (DARPA), Washington, DC *[Invited Lecture]*

2007 Lecture on *The Effects of Fatigue and Pharmacological Countermeasures on Judgment and Decision-Making*, U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL *[Invited Lecture]*

2008 Lecture on the *Validation of Actigraphy and the SHARP as Methods of Measuring Sleep and Performance in Soldiers*, U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL *[Seminar]*

2009 Lecture on Sleep Deprivation, *Executive Function, and Resilience to Sleep Loss*: Walter Reed Army Institute of Research AIBS Review, Washington DC *[Invited Lecture]*

2009 Lecture Entitled *Influences of Combat Exposure and Sleep Deprivation on Risky Decision-Making*, Evans U.S. Army Hospital, Fort Carson, CO *[Invited Lecture]*

2009 Lecture on *Making Bad Choices: The Effects of Combat Exposure and Sleep Deprivation on Risky Decision-Making*, 4th Army, Division West, Quarterly Safety Briefing to the Commanding General and Staff, Fort Carson, CO*[Invited Lecture]*

2011 Lecture Entitled *The effects of emotional intelligence on judgment and decision making, Military Operational Medicine Research Program Task Area C*, R & A Briefing, Walter Reed Army Institute of Research, Silver Spring, MD *[Invited Lecture]*

2011 Lecture Entitled *Effects of bright light therapy on sleep, cognition, brain function, and neurochemistry following mild traumatic brain injury*, Military Operational Medicine Research Program Task Area C, R & A Briefing, Walter Reed Army Institute of Research, Silver Spring, MD *[Invited Lecture]*

2012 Briefing to GEN (Ret) George Casey Jr., former Chief of Staff of the U.S. Army, entitled *Research for the Soldier*. McLean Hospital, Belmont, MA. *[Invited Lecture]*

2012 Lecture Entitled *Effects of bright light therapy on sleep, cognition, brain function, and neurochemistry following mild traumatic brain injury*, Military Operational Medicine Research Program In Progress Review (IPR) Briefing, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD *[Invited Lecture]*

2013 Lecture Entitled *Update on the Effects of Bright light therapy on sleep, cognition, brain function, and neurochemistry following mild traumatic brain injury*, Military Operational Medicine Research Program In Progress Review (IPR) Briefing, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD *[Invited Lecture]*

2013 Lecture Entitled *Internet Based Cognitive Behavioral Therapy: Effects on Depressive Cognitions and Brain Function*, Military Operational Medicine Research Program In Progress Review (IPR) Briefing, U.S. Army Medical Research and Materiel Command,

Fort Detrick, MD [*Invited Lecture*]

2013 Seminar Entitled *Predicting Resilience Against Sleep Loss*, United States Military Academy at West Point, West Point, NY [*Invited Symposium*].

2014 Lecture entitled *Sleep Loss, Brain Function, and Cognitive Performance*, presented to the Psychiatric Genetics and Translational Research Seminar, Massachusetts General Hospital/Harvard Medical School, Boston, MA *[Invited Lecture]*

2014 Grand Rounds Lecture entitled *Sleep Loss, Brain Function, and Performance of the Emotional-Executive System*. University of Arizona Psychiatry Grand Rounds, Tucson, AZ *[Invited Lecture]*

2014 Psychology Department Colloquium entitled *Sleep Loss, Brain Function, and Performance of the Emotional-Executive System*. University of Arizona Department of Psychology, Tucson, AZ *[Invited Lecture]*

2014 Lecture Entitled *Internet Based Cognitive Behavioral Therapy: Effects on Depressive Cognitions and Brain Function*, Military Operational Medicine Research Program In Progress Review (IPR) Briefing, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD *[Invited Lecture]*

2014 Lecture Entitled *The Neurobiological Basis and Potential Modification of Emotional Intelligence Through Affective/Behavioral Training*, Military Operational Medicine Research Program In Progress Review (IPR) Briefing, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD *[Invited Lecture]*

2015 Lecture Entitled Multimodal Neuroimaging to Predict Resistance to Sleep Deprivation, presented at the Pulmonary Research Conference, Department of Medicine, Sleep Medicine Sleep Lecture Series, University of Arizona College of Medicine, Tucson, AZ *[Invited Lecture]*.

2015 Lecture entitled Sleep Deprivation Selectively Impairs Emotional Aspects of Cognition. Presented at the Pamela Turbeville Speaker Series, McClelland Institute for Children, Youth, and Families, Tucson, AZ, *[Invited Lecture]*

2015 Lecture Entitled *Effects of bright light therapy on sleep, cognition, brain function, and neurochemistry following mild traumatic brain injury*, Military Operational Medicine Research Program In Progress Review (IPR) Briefing, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD *[Invited Lecture]*

2015 Lecture Entitled *A Non-Pharmacologic Method for Enhancing Sleep in PTSD*, Military Operational Medicine Research Program In Progress Review (IPR) Briefing, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD *[Invited Lecture]*

2015 Lecture Entitled *Internet Based Cognitive Behavioral Therapy: Effects on Depressive Cognitions and Brain Function*, Military Operational Medicine

Research Program In Progress Review (IPR) Briefing, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD *[Invited Lecture]*

2015 Lecture Entitled *Operating Under the Influence: The Effects of Sleep Loss and Stimulants on Decision-Making and Performance.* Presented at the annual SAFER training for interns and residents, University of Arizona Department of Psychiatry, Tucson AZ *[Invited Lecture]*

2016 Lecture entitled *Translational Neuroimaging: Using MRI Techniques to Promote Recovery and Resilience*. Functional Neuroimaging Course, Spring 2016, Psychology Department, University of Arizona, Tucson, AZ *[Invited Lecture]*

2016 Lecture entitled *Supporting Cognitive and Emotional Health in Warfighters*. Presented at the Department of Behavioral Biology, Walter Reed Army Institute of Research, Silver Spring, MD *[Invited Lecture]*

2016 Lecture Entitled *Internet Based Cognitive Behavioral Therapy: Effects on Depressive Cognitions and Brain Function*, Military Operational Medicine Research Program In Progress Review (IPR) Briefing, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD *[Invited Lecture]*

2016 Lecture Entitled *A Model for Predicting Cognitive and Emotional Health from Structural and Functional Neurocircuitry following TBI*, Military Operational Medicine Research Program In Progress Review (IPR) Briefing, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD *[Invited Lecture]*

2016 Lecture Entitled *Refinement and Validation of a Military Emotional Intelligence Training Program*, Military Operational Medicine Research Program In Progress Review (IPR) Briefing, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD *[Invited Lecture]*

Symposia/Conferences

1999 Oral Platform Presentation entitled *Functional MRI lateralization during memory encoding predicts seizure outcome following anterior temporal lobectomy*, 27th Annual Meeting of the International Neuropsychological Society, Boston, MA. *[Submitted Presentation]*

2000 Lecture on the *Neurobiology of Emotional Development in Children*, 9th Annual Parents as Teachers Born to Learn Conference, St. Louis, MO *[Invited Lecture]*

2001 Oral Platform Presentation entitled *Sex differences in functional activation of the amygdala during the perception of happy faces*, 29th Annual Meeting of the International Neuropsychological Society, Chicago, IL. *[Submitted Presentation]*

2002 Oral Platform Presentation entitled *Developmental changes in the lateralized activation of the prefrontal cortex and amygdala during the processing of facial affect*, 30th Annual Meeting of the International Neuropsychological Society, Toronto, Ontario, Canada.

[Submitted Presentation]

2002 Oral Platform Presentation *Gray and white matter volume during adolescence correlates with cognitive performance: A morphometric MRI study*, 30th Annual Meeting of the International Neuropsychological Society, Toronto, Ontario, Canada. *[Submitted Presentation]*

2004 Lecture on *Sleep Deprivation, Cognition, and Stimulant Countermeasures*: Seminar Presented at the Bi-Annual 71F Research Psychology Short Course, Ft. Detrick, MD, U.S. Army Medical Research and Materiel Command *[Invited Lecture]*

2004 Lecture on the *Regional Cerebral Blood Flow Correlates of Electroencephalographic Activity During Stage 2 and Slow Wave Sleep: An H215O PET Study*: Presented at the Bi-Annual 71F Research Psychology Short Course, Ft. Detrick, MD, U.S. Army Medical Research and Materiel Command *[Invited Lecture]*

2004 Oral Platform Presentation entitled *Regional cerebral metabolic correlates of electroencephalographic activity during stage-2 and slow-wave sleep: An H215O PET Study*, 18th Associated Professional Sleep Societies Annual Meeting, Philadelphia, PA. *[Submitted Presentation]*

2006 Lecture on *The Sleep History and Readiness Predictor*: Presented at the Bi-Annual 71F Research Psychology Short Course, Ft. Rucker, AL, U.S. Army Medical Research and Materiel Command *[Invited Lecture]*

2007 Symposium on *Cortical and Limbic Activation in Response to Visual Images of Low and High-Caloric Foods*, 6th Annual Meeting of the International Society for Behavioral Nutrition and Physical Activity (ISBNPA), Oslo, Norway *[Invited Lecture]*

2008 Lecture on *Sleep Deprivation, Executive Function, & Resilience to Sleep Loss*, First Franco-American Workshop on War Traumatism, IMNSSA, Toulon, France *[Invited Lecture]*

2009 Symposium Entitled *Sleep Deprivation, Judgment, and Decision-Making*, 23rd Annual Meeting of the Associated Professional Sleep Societies, Seattle, WA *[Invited Symposium]*

2009 Symposium Session Moderator for *Workshop on Components of Cognition and Fatigue: From Laboratory Experiments to Mathematical Modeling and Operational Applications*, Washington State University, Spokane, WA *[Invited Speaker]*

2009 Lecture on *Comparative Studies of Stimulant Action as Countermeasures for Higher Order Cognition and Executive Function Impairment that Results from Disrupted Sleep Patterns*, Presented at the NIDA-ODS Symposium entitled: Caffeine: Is the Next Problem Already Brewing, Rockville, MD *[Invited Lecture]*

2010 Oral Platform Presentation entitled *Sleep deprivation selectively impairs emotional aspects of cognitive functioning*, 27th Army Science Conference, Orlando, FL. *[Submitted Presentation]*

2010 Oral Platform Presentation entitled *Exaggerated amygdala responses to masked fearful faces are specific to PTSD versus simple phobia*, 27th Army Science Conference, Orlando, FL. *[Submitted Presentation]*

2012 Oral Symposium Presentation entitled *Shared and distinctive patterns of cortico-limbic activation across anxiety disorders*, 32nd Annual Conference of the Anxiety Disorders Association of America, Arlington, VA. *[Invited Symposium]*

2012 Oral Platform Presentation entitled *Shared and unique patterns of cortico-limbic activation across anxiety disorders*. 40th Meeting of the International Neuropsychological Society, Montreal, Canada. *[Submitted Presentation]*

2013 Lecture entitled *Brain responses to visual images of food: Could your eyes be the gateway to excess?* Presented to the NIH Nutrition Coordinating Committee and the Assistant Surgeon General of the United States, Bethesda, MD *[Invited Lecture]*

2014 Symposium Entitled *Operating Under the Influence: The Effects of Sleep Loss and Stimulants on Decision-Making and Performance*, Invited Faculty Presenter at the 34th Annual Cardiothoracic Surgery Symposium (CREF), San Diego, CA [*Invited Symposium*].

2014 Symposium Entitled *The Effects of Sleep Loss on Food Preference*, SLEEP 2014, Minneapolis, MN *[Invited Symposium]*

2015 Symposium Entitled *The Neurobiological Basis and Potential Modification of Emotional Intelligence in Military Personnel*. Invited presentation at the Yale Center for Emotional Intelligence, New Haven, CT *[Invited Lecture]*

2015 Lecture Entitled *Predicting Resilience to Sleep Loss with Multi-Modal Neuroimaging*. Invited presentation at the DARPA Sleep Workshop 2015, Arlington, VA *[Invited Lecture]*

2015 Symposium Entitled: *The Brain and Food: How your (sleepy) Eyes Might be the Gateway to Excess*, Invited Faculty Presenter at the 2015 University of Arizona Update on Psychiatry, Tucson, AZ [*Invited Symposium*].

2015 Oral Platform presentation entitled *Multimodal Neuroimaging to Predict Resistance to Sleep Deprivation*, Associated Professional Sleep Societies (APSS) SLEEP meeting, Seattle, WA *[Submitted Presentation]*

2015 Symposium Entitled presentation entitled *Sleep Deprivation and Emotional Decision Making*, Virginia Tech Sleep Workshop, Arlington, VA *[Invited Symposium]*

2016 Oral Platform presentation entitled *Default Mode Activation Predicts Vulnerability to Sleep Deprivation in the Domains of Mood, Sleepiness, and Vigilance*, Associated Professional Sleep Societies (APSS) SLEEP meeting, Denver, CO *[Submitted Presentation]*

2016 Oral Platform presentation entitled *Short Wavelength Light Therapy Facilitates Recovery from Mild Traumatic Brain Injury*, Military Health Systems Research Symposium (MHSRS), Orlando, FL *[Submitted Presentation]*

Peer Reviewed Published Abstracts

1. **Killgore, WD.** Development and validation of a new instrument for the measurement of transient mood states: The facial analogue mood scale (FAMS) [Abstract]. Dissertation Abstracts International: Section B: The Sciences & Engineering 1995; 56 (6-B): 3500.

2. **Killgore, WD,** & Locke, B. A nonverbal instrument for the measurement of transient mood states: The Facial Analogue Mood Scale (FAMS) [Abstract]. Proceedings of the Annual Conference of the Oklahoma Center for Neurosciences 1996, Oklahoma City, OK.

3. **Killgore, WD,** Scott, JG, Oommen, KJ, & Jones, H. Lateralization of seizure focus and performance on the MMPI-2 [Abstract]. Proceedings of the Annual Conference of the Oklahoma Center for Neurosciences 1996, Oklahoma City, OK.

4. **Killgore, WD,** & Adams, RL. Vocabulary ability and Boston Naming Test performance: Preliminary guidelines for interpretation [Abstract]. Archives of Clinical Neuropsychology 1997; 13(1).

5. **Killgore, WD**, Glosser, G, Cooke, AN, Grossman, M, Maldjian, J, Judy, K, Baltuch, G, King, D, Alsop, D, & Detre, JA. Functional activation during verbal memory encoding in patients with lateralized focal lesions [Abstract]. Epilepsia 1998; 39(Suppl. 6): 99.

6. **Killgore, WD.** A new method for assessing subtle cognitive deficits: The Clock Trail Making Test [Abstract]. Archives of Clinical Neuropsychology 1998; 14(1): 92.

7. **Killgore, WD,** & DellaPietra, L. Item response biases on the WMS-III Auditory Delayed Recognition Subtests [Abstract]. Archives of Clinical Neuropsychology 1998; 14(1): 92.

8. **Killgore, WD,** Glosser, G, Alsop, DC, Cooke, AN, McSorley, C, Grossman, M, & Detre, JA. Functional activation during material specific memory encoding [Abstract]. NeuroImage 1998; 7: 811.

9. **Killgore, WD,** & DellaPietra, L. Using the WMS-III to detect malingering: Empirical development of the Rarely Missed Index. [Abstract]. Journal of the International Neuropsychological Society 1999; 5(2).

10. **Killgore, WD,** Glosser, G, & Detre, JA. Prediction of seizure outcome following anterior temporal lobectomy: fMRI vs. IAT [Abstract]. Archives of Clinical Neuropsychology 1999; 14(1): 143.

11. **Killgore, WD,** Glosser, G, King, D, French, JA, Baltuch, G, & Detre, JA. Functional MRI

lateralization during memory encoding predicts seizure outcome following anterior temporal lobectomy [Abstract]. Journal of the International Neuropsychological Society 1999; 5(2): 122.

12. **Killgore, WD,** Casasanto, DJ, Maldjian, JA, Alsop, DC, Glosser, G, French, J, & Detre, J. A. Functional activation of mesial temporal lobe during nonverbal encoding [abstract]. Epilepsia, 1999; 40 (Supplement 7): 188.

13. **Killgore, WD,** Casasanto, DJ, Maldjian, JA, Gonzales-Atavales, J, & Detre, JA. Associative memory for faces preferentially activates the left amygdala and hippocampus [abstract]. Journal of the International Neuropsychological Society, 2000; 6: 157.

14. Casasanto, DJ, **Killgore, WD,** Maldjian, JA, Gonzales-Atavales, J, Glosser, G, & Detre, JA. Task-dependent and task-invariant activation in mesial temporal lobe structures during fMRI explicit encoding tasks [abstract]. Journal of the International Neuropsychological Society, 2000; 6: 134. ***[*Winner of Rennick Research Award]***.

15. **Killgore, WD,** Glahn, D, & Casasanto, DJ. Development and validation of the Design Organization Test (DOT): A rapid screening instrument for assessing for visuospatial ability [abstract]. Journal of the International Neuropsychological Society, 2000; 6: 147.

16. Casasanto DJ, **Killgore, WD,** Glosser, G, Maldjian, JA, & Detre, JA. Hemispheric specialization during episodic memory encoding in the human hippocampus and MTL. Proceedings of the Society for Cognitive Science 2000: Philadelphia, PA.

17. Casasanto, DJ, Glosser, G, **Killgore, WD,** Siddiqi, F, Falk, M, Maldjian, J, Lev-Reis, I, & Detre, JA. FMRI evidence for the functional reserve model of post-ATL neuropsychological outcome prediction. Poster Presented at the David Mahoney Institute of Neurological Sciences 17th Annual Neuroscience Retreat, University of Pennsylvania, April 17, 2000.

18. Casasanto, DJ, **Killgore, WD,** Maldjian, JA, Glosser, G, Grossman, M, Alsop, D. C, & Detre, JA. Neural Correlates of Successful and Unsuccessful Verbal Encoding [abstract]. Neuroimage, 2000 11: S381.

19. Siddiqui, F, Casasanto, DJ, **Killgore, WD,** Detre, JA, Glosser, G, Alsop, DC, & Maldjian, JA. Hemispheric effects of frontal lobe tumors on mesial temporal lobe activation during scene encoding [abstract]. Neuroimage, 2000 11: S448.

20. Oki, M, Gruber, SA, **Killgore, WD,** Yurgelun-Todd, DA. Bilateral thalamic activation occurs during lexical but not semantic processing [abstract]. Neuroimage, 2000 11: S353.

21. Yurgelun-Todd, DA, Gruber, SA, **Killgore, WD,** & Tohen, M. Neuropsychological performance in first-episode bipolar disorder [Abstract]. Collegium Internationale Neuro-Psychopharmacologicum. Brussels, Belgium. July, 2000.

22. **Killgore, WD,** & DellaPietra, L. Detecting malingering with the WMS-III: A revision of the Rarely Missed Index (RMI) [abstract]. Journal of the International Neuropsychological Society, 2001; 7 (2): 143-144.

23. Casasanto, DJ, Glosser, G, **Killgore, WD,** Siddiqi, F, Falk, M, Roc, A, Maldjian, JA, Levy-Reis, I, Baltuch, G, & Detre, JA. Presurgical fMRI predicts memory outcome following anterior temporal lobectomy [abstract]. Journal of the International Neuropsychological Society, 2001; 7 (2): 183.

24. **Killgore, WD,** & Yurgelun-Todd, DA. Amygdala but not hippocampal size predicts verbal memory performance in bipolar disorder [abstract]. Journal of the International Neuropsychological Society, 2001; 7 (2): 250-251.

25. **Killgore, WD,** Kanayama, G, & Yurgelun-Todd, DA. Sex differences in functional activation of the amygdala during the perception of happy faces [abstract]. Journal of the International Neuropsychological Society, 2001; 7 (2): 198.

26. **Killgore, WD,** Gruber, SA, Oki, M, & Yurgelun-Todd, DA. Amygdalar volume and verbal memory in schizophrenia and bipolar disorder: A correlative MRI study [abstract]. Meeting of the International Congress on Schizophrenia Research. Whistler, British Columbia. April 2001.

27. Kanayama, G, **Killgore, WD,** Gruber, SA, & Yurgelun-Todd, DA. FMRI BOLD activation of the supramarginal gyrus in schizophrenia [abstract]. Meeting of the International Congress on Schizophrenia Research. Whistler, British Columbia. April 2001.

28. Gruber, SA, **Killgore, WD,** Renshaw, PF, Pope, HG. Jr, Yurgelun-Todd, DA. Gender differences in cerebral blood volume after a 28-day washout period in chronic marijuana smokers [abstract]. Meeting of the International Congress on Schizophrenia Research. Whistler, British Columbia. April 2001.

29. Rohan, ML, **Killgore, WD,** Eskesen, JG, Renshaw, PF, & Yurgelun-Todd, DA. Match-warped EPI anatomic images and the amygdala: Imaging in hard places. Proceedings of the International Society for Magnetic Resonance in Medicine, 2001; 9: 1237.

30. **Killgore, WD** & Yurgelun-Todd, DA. Developmental changes in the lateralized activation of the prefrontal cortex and amygdala during the processing of facial affect [Abstract]. Oral platform paper presented at the 30th Annual Meeting of the International Neuropsychological Society, Toronto, Ontario, Canada, February 13-16, 2002.

31. Yurgelun-Todd, DA. & **Killgore, WD.** Gray and white matter volume during adolescence correlates with cognitive performance: A morphometric MRI study [Abstract]. Oral platform paper presented at the 30th Annual Meeting of the International Neuropsychological Society, Toronto, Ontario, Canada, February 13-16, 2002.

32. **Killgore, WD,** Reichardt, R. Kautz, M, Belenky, G, Balkin, T, & Wesensten, N. Daytime melatonin-zolpidem cocktail: III. Effects on salivary melatonin and performance [abstract]. Poster presented at the 17th Annual Meeting of the Associated Professional Sleep Societies, Chicago, Illinois, June 3-8, 2003.

33. **Killgore, WD,** Young, AD, Femia, LA, Bogorodzki, P, Rogowska, J, & Yurgelun-Todd, DA.

Cortical and limbic activation during viewing of high- versus low-calorie foods [abstract]. Poster Presented at the Organization for Human Brain Mapping Annual Meeting, New York, NY, June 18-22, 2003.

34. **Killgore, WD,** & Yurgelun-Todd, DA. Amygdala activation during masked presentations of sad and happy faces [abstract]. Poster presented at the Organization for Human Brain Mapping Annual Meeting, New York, NY, June 18-22, 2003.

35. **Killgore, WD,** Stetz, MC, Castro, CA, & Hoge, CW. Somatic and emotional stress symptom expression prior to deployment by soldiers with and without previous combat experience [abstract]. Poster presented at the 6th Annual Force Health Protection Conference, Albuquerque, NM, August, 11-17, 2003. ***[*Best Paper Award]***

36. Wesensten, NJ, Balkin, TJ, Thorne, D, **Killgore, WD,** Reichardt, R, & Belenky, G. Caffeine, dextroamphetamine, and modafinil during 85 hours of sleep deprivation: I. Performance and alertness effects [abstract]. Poster presented at the 75th Annual Meeting of the Aerospace Medical Association, Anchorage, AK, May 2-6 2004.

37. **Killgore, WD,** Braun, AR, Belenky, G, Wesensten, NJ, & Balkin, TJ. Regional cerebral metabolic correlates of electroencephalographic activity during stage-2 and slow-wave sleep: An H215O PET Study [abstract]. Oral platform presentation at the 18th Associated Professional Sleep Societies Annual Meeting, Philadelphia, PA, June 5-10, 2004.

38. **Killgore, WD,** Arora, NS, Braun, AR, Belenky, G, Wesensten, NJ, & Balkin, TJ. Sleep strengthens the effective connectivity among cortical and subcortical regions: Evidence for the restorative effects of sleep using H215O PET [abstract]. Poster presented at the 17th Congress of the European Sleep Research Society, Prague, Czech Republic, October 5-9, 2004.

39. **Killgore, WD,** Arora, NS, Braun, AR, Belenky, G, Wesensten, NJ, & Balkin, TJ An H215O PET study of regional cerebral activation during stage 2 sleep [abstract]. Poster presented at the 17th Congress of the European Sleep Research Society, Prague, Czech Republic, October 5-9, 2004.

40. Wesensten, N, **Killgore, WD,** Belenky, G, Reichardt, R, Thorne, D, & Balkin, T. Caffeine, dextroamphetamine, and modafinil during 85 H of sleep deprivation. II. Effects of tasks of executive function [abstract]. Poster presented at the 17th Congress of the European Sleep Research Society, Prague, Czech Republic, October 5-9, 2004.

41. Balkin, T, Reichardt, R, Thorne, D, **Killgore, WD,** Belenky, G, & Wesensten, N. Caffeine, dextroamphetamine, and modafinil during 85 hours of sleep deprivation. I. Psychomotor vigilance and objective alertness effects [abstract]. Oral paper presentation at the 17th Congress of the European Sleep Research Society, Prague, Czech Republic, October 5-9, 2004.

42. Belenky, G, Reichardt, R, Thorne, D, **Killgore, WD,** Balkin, T, & Wesensten, N. Caffeine, dextroamphetamine, and modafinil during 85 hours of sleep deprivation. III. Effect on recovery sleep and post-recovery sleep performance [abstract]. Oral paper presentation at the 17th Congress of the European Sleep Research Society, Prague, Czech Republic, October 5-9,

2004.

43. Vo, A, Green, J, Campbell, W, **Killgore, WD,** Labutta, R, & Redmond, D. The quantification of disrupted sleep in migraine via actigraphy: A pilot study [abstract]. Abstract presented at the Associated Professional Sleep Societies 19th Annual Meeting, Denver, CO, June 18-23, 2005. SLEEP, 28 (Supplement), A281.

44. Kendall, AP, **Killgore, WD,** Kautz, M, & Russo, MB. Left-visual field deficits in attentional processing after 40 hours of sleep deprivation [abstract]. Abstract presented at the Associated Professional Sleep Societies 19th Annual Meeting, Denver, CO, June 18-23, 2005. SLEEP, 28 (Supplement), A143.

45. Reichardt, RM, Grugle, NL, Balkin, TJ, & **Killgore, WD.** Stimulant countermeasures, risk propensity, and IQ across 2 nights of sleep deprivation [abstract]. Abstract presented at the Associated Professional Sleep Societies 19th Annual Meeting, Denver, CO, June 18-23, 2005. SLEEP, 28 (Supplement), A145.

46. Killgore, DB, McBride, SA, Balkin, TJ, & **Killgore, WD.** Post-stimulant hangover: The effects of caffeine, modafinil, and dextroamphetamine on sustained verbal fluency following sleep deprivation and recovery sleep [abstract]. Abstract presented at the Associated Professional Sleep Societies 19th Annual Meeting, Denver, CO, June 18-23, 2005. SLEEP, 28 (Supplement), A137.

47. **Killgore, WD,** Balkin, TJ, & Wesensten, NJ. Impaired decision-making following 49 hours of sleep deprivation [abstract]. Abstract presented at the Associated Professional Sleep Societies 19th Annual Meeting, Denver, CO, June 18-23, 2005. SLEEP, 28 (Supplement), A138.

48. **Killgore, WD,** McBride, SA, Killgore, DB, & Balkin, TJ. Stimulant countermeasures and risk propensity across 2 nights of sleep deprivation [abstract]. Abstract presented at the Associated Professional Sleep Societies 19th Annual Meeting, Denver, CO, June 18-23, 2005. SLEEP, 28 (Supplement), A136.

49. McBride, SA, Balkin, TJ, & **Killgore, WD.** The effects of 24 hours of sleep deprivation on odor identification accuracy [abstract]. Abstract presented at the Associated Professional Sleep Societies 19th Annual Meeting, Denver, CO, June 18-23, 2005. SLEEP, 28 (Supplement), A137.

50. Picchioni, D, **Killgore, WD,** Braun, AR, & Balkin, TJ. PET correlates of EEG activity during non-REM sleep. Poster presentation at the annual UCLA/Websciences Sleep Training Workshop, Lake Arrowhead, CA, September, 2005.

51. **Killgore, WD,** Killgore, DB, McBride, SA, & Balkin, TJ. Sustained verbal fluency following sleep deprivation and recovery sleep: The effects of caffeine, modafinil, and dextroamphetamine. Poster presented at the 34th Meeting of the International Neuropsychological Society, Boston, MA, February 1-4, 2006.

52. **Killgore, WD,** Balkin, TJ, & Wesensten, NJ. Decision-making is impaired following 2-days of sleep deprivation. Poster presented at the 34th Meeting of the International

Neuropsychological Society, Boston, MA, February 1-4, 2006.

53. **Killgore, WD,** & Yurgelun-Todd, DA. Neural correlates of emotional intelligence in adolescent children. Poster presented at the 34th Meeting of the International Neuropsychological Society, Boston, MA, February 1-4, 2006.

54. **Killgore, WD,** & Yurgelun-Todd, DA. Social anxiety predicts amygdala activation in adolescents viewing fearful faces. Poster presented at the 34th Meeting of the International Neuropsychological Society, Boston, MA, February 1-4, 2006.

55. McBride, SA & **Killgore, WD.** Sleepy people smell worse: Olfactory deficits following extended wakefulness. Paper presented at the Workshop on Trace Gas Detection Using Artificial, Biological, and Computational Olfaction. Monell Chemical Senses Center, Philadelphia, PA, March 29-31, 2006.

56. **Killgore, WD,** Day LM, Li, C, Kamimori, GH, Balkin, TJ, & Killgore DB. Moral reasoning is affected by sleep deprivation [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A137.

57. **Killgore, WD,** Killgore DB, Kahn-Green, E, Conrad, A, Balkin, TJ, & Kamimori, G. H. Introversion-Extroversion predicts resilience to sleep loss [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A137.

58. Newman, R, Kamimori, GH, **Killgore, WD.** Sleep deprivation diminishes constructive thinking [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A136-137.

59. Huck, NO, Kendall, AP, McBride, SA, **Killgore, WD.** The perception of facial emotion is enhanced by psychostimulants following two nights of sleep deprivation [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A136.

60. O'Sullivan, M, Reichardt, RM, Krugler, AL, Killgore, DB, & **Killgore, WD.** Premorbid intelligence correlates with duration and quality of recovery sleep following sleep deprivation [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A372.

61. McBride, SA, **Killgore, WD,** Kahn-Green, E, Conrad, A, & Kamimori, GH. Caffeine administered to maintain overnight alertness does not disrupt performance during the daytime withdrawal period [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A136.

62. McBride, SA, Killgore DB, Balkin, TJ, Kamimori, GH, & **Killgore, WD.** Sleepy people smell worse: Olfactory decrements as a function of sleep deprivation [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June

17-22, 2006. SLEEP, 29 (Supplement), A135.

63. Day, LM, Li, C, Killgore, DB, Kamimori, GH, & **Killgore, WD.** Emotional intelligence moderates the effect of sleep deprivation on moral reasoning [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A135.

64. Murray, CJ, Killgore, DB, Kamimori, GH, & **Killgore, WD.** Individual differences in stress management capacity predict responsiveness to caffeine during sleep deprivation [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A43.

65. Murray, CJ, Newman, R, O'Sullivan, M, Killgore, DB, Balkin, TJ, & **Killgore, WD.** Caffeine, dextroamphetamine, and modafinil fail to restore Stroop performance during sleep deprivation [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A370-371.

66. Richards, J, Killgore, DB, & **Killgore, WD.** The effect of 44 hours of sleep deprivation on mood using the Visual Analog Mood Scales [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A132.

67. Richards, J, & **Killgore, WD.** The effect of caffeine, dextroamphetamine, and modafinil on alertness and mood during sleep deprivation [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A43.

68. Lipizzi, EL, Leavitt, BP, Killgore, DB, Kamimori, GH, & **Killgore, WD.** Decision making capabilities decline with increasing duration of wakefulness [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A131.

69. Lipizzi, EL, Killgore, DB, Kahn-Green, E, Kamimori, GH, & **Killgore, WD.** Emotional intelligence scores decline during sleep deprivation [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A131.

70. Kahn-Green, E, Day, L, Conrad, A, Leavitt, BP, Killgore, DB, & **Killgore, WD.** Short-term vs. long-term planning abilities: Differential effects of stimulants on executive function in sleep deprived individuals [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A370.

71. Kahn-Green, E, Conrad, A, Killgore, DB, Kamimori, GH, & **Killgore, WD.** Tired and frustrated: Using a projective technique for assessing responses to stress during sleep deprivation [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A130.

72. Killgore, DB, Kahn-Green, E, Balkin, TJ, Kamimori, GH, & **Killgore, WD.** 56 hours of wakefulness is associated with a sub-clinical increase in symptoms of psychopathology [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A130.

73. Killgore, DB, McBride, SA, Balkin, TJ, Leavitt, BP, & **Killgore, WD.** Modafinil improves humor appreciation during sleep deprivation [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A42.

74. Reichardt, RM, Killgore, DB, Lipizzi, EL, Li, CJ, Krugler, AL, & **Killgore, WD.** The effects of stimulants on recovery sleep and post-recovery verbal performance following 61-hours of sleep deprivation [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A42.

75. Bailey, JD, Richards, J, & **Killgore, WD.** Prediction of mood fluctuations during sleep deprivation with the SAFTE Model [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A60.

76. Kendall, AP, McBride, S. A, & **Killgore, WD.** Visuospatial perception of line orientation is resistant to one night of sleep loss [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A369.

77. Kendall, AP, McBride, SA, Kamimori, GH, & **Killgore, WD.** The interaction of coping skills and stimulants on sustaining vigilance: Poor coping may keep yoiu up at night [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A129.

78. Muckle, A, Killgore, DB, & **Killgore, WD.** Gender differences in the effects of stimulant medications on the ability to estimate unknown quantities when sleep deprived [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A369.

79. Krugler, AL, **Killgore, WD,** & Kamimori, G. H. Trait anger predicts resistance to sleep loss [abstract]. Abstract presented at the 20th Meeting of the Associated Professional Sleep Societies, Salt Lake City, UT, June 17-22, 2006. SLEEP, 29 (Supplement), A129.

80. **Killgore, WD,** Cotting, DI, Vo, A. H, Castro, CA, & Hoge, CW. The invincibility syndrome: Combat experiences predict risk-taking propensity following redeployment [abstract]. Abstract presented at the 9th Annual Force Health Protection Conference, Albuquerque, NM, August 6-11, 2006.

81. **Killgore, WD,** Wesensten, NJ, & Balkin, TJ. Stimulants improve tactical but not strategic planning during prolonged wakefulness [abstract]. Abstract presented at the 9th Annual Force Health Protection Conference, Albuquerque, NM, August 6-11, 2006.

82. **Killgore, WD,** Balkin, TJ, Wesensten, NJ, & Kamimori, G. H. The effects of sleep loss and caffeine on decision-making [abstract]. Abstract presented at the 9th Annual Force Health Protection Conference, Albuquerque, NM, August 6-11, 2006.

83. **Killgore, WD,** Balkin, TJ, & Kamimori, GH. Sleep loss can impair moral judgment [abstract]. Abstract presented at the 9th Annual Force Health Protection Conference, Albuquerque, NM, August 6-11, 2006.

84. **Killgore, WD,** Lipizzi, EL, Reichardt, RM, Kamimori, GH, & Balkin, TJ. Can stimulants reverse the effects of sleep deprivation on risky decision-making [abstract]? Abstract presented at the 25th Army Science Conference, Orlando, FL, November 27-30, 2006.

85. **Killgore, WD,** Killgore, DB, Kamimori, GH, & Balkin, TJ. Sleep deprivation impairs the emotional intelligence and moral judgment capacities of Soldiers [abstract]. Abstract presented at the 25th Army Science Conference, Orlando, FL, November 27-30, 2006.

86. **Killgore, WD,** Cotting, DI, Vo, AH, Castro, C.A, & Hoge, CW. The post-combat invincibility syndrome: Combat experiences increase risk-taking propensity following deployment [abstract]. Abstract presented at the 25th Army Science Conference, Orlando, FL, November 27-30, 2006.

87. Adam, GE, Szelenyi, ER, **Killgore, WD,** & Lieberman, HR. A double-blind study of two days of caloric deprivation: Effects on judgment and decision-making. Oral paper presentation at the Annual Scientific Meeting of the Aerospace Medical Association, New Orleans, LA, May, 2007.

88. Killgore, DB, Kahn-Greene, ET, Kamimori, GH, & **Killgore, WD.** The effects of acute caffeine withdrawal on short category test performance in sleep deprived individuals [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A43.

89. Richards, JM, Lipizzi, EL, Kamimori, GH, & **Killgore, WD.** Extroversion predicts change in attentional lapses during sleep deprivation [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A137.

90. Lipizzi, EL, Richards, JM, Balkin, TJ, Grugle, NL, & **Killgore, WD.** Morningness-Eveningness and Intelligence [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A345.

91. Lipizzi, EL, Richards, Balkin, TJ, Grugle, NL, & **Killgore WD.** Morningness-Eveningness affects risk-taking propensity during sleep deprivation [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A136.

92. McBride, SA, Ganesan, G, Kamimori, GH, & **Killgore, WD.** Odor identification ability predicts vulnerability to attentional lapses during 77 hours of sleep deprivation [abstract]. Abstract

presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A135.

93. Smith, KL, McBride, S. A, Kamimori, GH, & **Killgore, WD.** Individual differences in odor discrimination predict mood dysregulation following 56 hours of sleep deprivation [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A136.

94. McBride, SA, Leavitt, BP, Kamimori, GH, & **Killgore, WD.** Odor identification accuracy predicts resistance to sleep loss. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A137.

95. Killgore, DB, McBride, SA, Balkin, TJ, Grugle, NL. & **Killgore, WD.** Changes in odor discrimination predict executive function deficits following 45 hours of wakefulness [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A136.

96. Rupp, TL, Killgore, DB, Balkin, TJ, Grugle, NL, & **Killgore, WD.** The effects of modafinil, dextroamphetamine, and caffeine on verbal and nonverbal fluency in sleep deprived individuals [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A43.

97. Newman, RA, Krugler, AL, Kamimori, GH, & **Killgore, WD.** Changes in state and trait anger following 56 hours of sleep deprivation [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A138.

98. Rupp, TL, Grugle, NL, Krugler, AL, Balkin, TJ, & **Killgore, WD.** Caffeine, dextroamphetamine, and modafinil improve PVT performance after sleep deprivation and recovery sleep [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A44.

99. **Killgore, WD,** Lipizzi, EL, Balkin, TJ, Grugle, NL, & Killgore, DB. The effects of sleep deprivation and stimulants on self-reported sensation seeking propensity [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A42.

100. **Killgore, WD,** Richards, JM, Balkin, TJ, Grugle, NL, & Killgore DB. The effects of sleep deprivation and stimulants on risky behavior [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A41.

101. Newman, RA, Smith, KL, Balkin, TJ, Grugle, NL, & **Killgore, WD.** The effects of caffeine, dextroamphetamine, and modafinil on executive functioning following 45 hours of sleep deprivation [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A45.

102. Richards, JM, Lipizzi, EL, Balkin, TJ, Grugle, NL, & **Killgore, WD.** Objective alertness predicts mood changes during 44 hours of sleep deprivation [abstract]. Abstract presented at the 21st Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. SLEEP, 30 (Supplement), A56.

103. **Killgore, WD,** & Yurgelun-Todd, DA. Cortical and Limbic Activation in Response to Visual Images of Low and High-Caloric Food [abstract]. Oral symposium presented at the 6th Annual Conference of the Society of Behavioral Nutrition and Physical Activity (ISBNPA), Oslo, Norway, June 20-23, 2007. Proceedings of the ISBNPA, 2007, 75.

104. Estrada, A, **Killgore, WD,** Rouse, T, Balkin, TJ, & Wildzunas, RM. Total sleep time measured by actigraphy predicts academic performance during military training [abstract]. Abstract presented at the 22nd Meeting of the Associated Professional Sleep Societies, Baltimore, MD, June 7-12, 2008. SLEEP, 31 (Supplement), A134.

105. **Killgore, WD,** Lipizzi, EL, Smith, KL, Killgore, DB, Rupp, TL, Kamimori, GH, & Balkin, T. J. Nonverbal intelligence is inversely related to the ability to resist sleep loss [abstract]. Abstract presented at the 22nd Meeting of the Associated Professional Sleep Societies, Baltimore, MD, June 7-12, 2008. SLEEP, 31 (Supplement), A134.

106. **Killgore, WD,** Lipizzi, EL, Killgore, DB, Rupp, TL, Kamimori, GH, & Balkin, TJ. Emotional intelligence predicts declines in emotion-based decision-making following sleep deprivation [abstract]. Abstract presented at the 22nd Meeting of the Associated Professional Sleep Societies, Baltimore, MD, June 7-12, 2008. SLEEP, 31 (Supplement), A134.

107. Reid, CT, Smith, K, **Killgore, WD,** Rupp, TL, & Balkin, TJ. Higher intelligence is associated with less subjective sleepiness during sleep restriction [abstract]. Abstract presented at the 22nd Meeting of the Associated Professional Sleep Societies, Baltimore, MD, June 7-12, 2008. SLEEP, 31 (Supplement), A375.

108. Newman, R, **Killgore, WD,** Rupp, T. L, & Balkin, TJ. Better baseline olfactory discrimination is associated with worse PVT and MWT performance with sleep restriction and recovery [abstract]. Abstract presented at the 22nd Meeting of the Associated Professional Sleep Societies, Baltimore, MD, June 7-12, 2008. SLEEP, 31 (Supplement), A375.

109. Smith, KL, Reid, CT, **Killgore, WD,** Rupp, TL, & Balkin, TJ. Personality factors associated with performance and sleepiness during sleep restriction and recovery [abstract]. Abstract presented at the 22nd Meeting of the Associated Professional Sleep Societies, Baltimore, MD, June 7-12, 2008. SLEEP, 31 (Supplement), A376.

110. Lipizzi, EL, **Killgore, WD,** Rupp, TL, & Balkin, TJ. Risk-taking behavior is elevated during recovery from sleep restriction [abstract]. Abstract presented at the 22nd Meeting of the Associated Professional Sleep Societies, Baltimore, MD, June 7-12, 2008. SLEEP, 31 (Supplement), A376.

111. Lipizzi, EL, Rupp, TL, **Killgore, WD,** & Balkin, TJ. Sleep restriction increases risk-taking behavior [abstract]. Poster presented at the 11th Annual Force Health Protection Conference,

Albuquerque, NM, August, 9-15, 2008.

112. **Killgore, WD,** Estrada, A, Balkin, TJ, & Wildzunas, RM. Sleep duration during army training predicts course performance [abstract]. Poster presented at the 6th Annual Force Health Protection Conference, Albuquerque, NM, August, 11-17, 2008.

113. **Killgore, WD,** Lipizzi, EL, Smith, KL, Killgore, DB, Rupp, TL, Kamimori, GH, & Balkin, TJ. Higher cognitive ability is associated with reduced relative resistance to sleep loss [abstract]. Poster presented at the 6th Annual Force Health Protection Conference, Albuquerque, NM, August, 11-17, 2008.

114. **Killgore, WD,** Rupp, TL, Grugle, NL, Lipizzi, EL, & Balkin, TJ. Maintaining alertness during sustained operations: Which stimulant is most effective after 44 hours without sleep [abstract]? Poster presented at the 6th Annual Force Health Protection Conference, Albuquerque, NM, August, 11-17, 2008.

115. **Killgore, WD,** Newman, RA, Lipizzi, EL, Kamimori, GH, & Balkin, TJ. Sleep deprivation increases feelings of anger but reduces verbal and physical aggression in Soldiers [abstract]. Poster presented at the 6th Annual Force Health Protection Conference, Albuquerque, NM, August, 11-17, 2008.

116. Kelley, AM, Dretsch, M, **Killgore, WD,** & Athy, JR. Risky behaviors and attitudes about risk in Soldiers. Abstract presented at the 29th Annual Meeting of the Society for Judgment and Decision Making, Chicago, IL, November, 2008.

117. **Killgore, WD,** Ross, AJ, Silveri, MM, Gruber, SA, Kamiya, T, Kawada, Y, Renshaw, PF, & Yurgelun-Todd, DA. Citicoline affects appetite and cortico-limbic responses to images of high calorie foods. Abstract presented at the Society for Neuroscience, Washington DC, November 19, 2008.

118. Britton, JC, Stewart, SE, Price, LM, **Killgore, WD,** Gold, AL, Jenike, MA, & Rauch, SL. Reduced amygdalar activation in response to emotional faces in pediatric Obsessive-Compulsive Disorder. Abstract presented at the Annual meeting of the American College of Neuropsychopharmacology, Scottsdale, AZ, December 7-11, 2008.

119. **Killgore, WD,** Balkin, TJ, Estrada, A, & Wildzunas, RM. Sleep and performance measures in soldiers undergoing military relevant training. Abstract presented at the 26th Army Science Conference, Orlando, FL, December 1-4, 2008.

120. **Killgore, WD** & Yurgelun-Todd, DA. Cerebral correlates of amygdala responses during non-conscious perception of affective faces in adolescent children. Abstract presented at the 37th Annual Meeting of the International Neuropsychological Society, Atlanta, GA, February 11-14, 2009.

121. **Killgore, WD,** Killgore, DB, Grugle, NL, & Balkin, TJ. Odor identification ability predicts executive function deficits following sleep deprivation. Abstract presented the 37th Annual Meeting of the International Neuropsychological Society, Atlanta, GA, February 11-14, 2009.

122. **Killgore, WD,** Rupp, TL, Killgore, DB, Grugle, NL, and Balkin, TJ. Differential effects of

stimulant medications on verbal and nonverbal fluency during sleep deprivation. Abstract presented the 37th Annual Meeting of the International Neuropsychological Society, Atlanta, GA, February 11-14, 2009.

123. **Killgore, WD,** Killgore, DB, Kamimori, GH, & Balkin, TJ. When being smart is a liability: More intelligent individuals may be less resistant to sleep deprivation. Abstract presented the 37th Annual Meeting of the International Neuropsychological Society, Atlanta, GA, February 11-14, 2009.

124. **Killgore, WD,** Britton, JC, Price, LM, Gold, AL, Deckersbach, T, & Rauch, SL. Introversion is associated with greater amygdala and insula activation during viewing of masked affective stimuli. Abstract presented the 37th Annual Meeting of the International Neuropsychological Society, Atlanta, GA, February 11-14, 2009.

125. **Killgore, WD,** Britton, JC, Price, LM, Gold, AL, Deckersbach, T, & Rauch, SL. Amygdala responses of specific animal phobics do not differ from healthy controls during masked fearful face perception. Abstract presented the 37th Annual Meeting of the International Neuropsychological Society, Atlanta, GA, February 11-14, 2009.

126. **Killgore, WD,** Britton, JC, Price, LM, Gold, AL, Deckersbach, T, & Rauch, SL. Small animal phobics show sustained amygdala activation in response to masked happy facial expressions. Abstract presented the 37th Annual Meeting of the International Neuropsychological Society, Atlanta, GA, February 11-14, 2009. ***[*Merit Poster Award]***

127. Price, LM, **Killgore, WD,** Britton, JC, Kaufman, ML, Gold, AL, Deckersbach, T, & Rauch, SL. Anxiety sensitivity correlates with insula activation in response to masked fearful faces in specific animal phobics and healthy subjects. Abstract presented at the Annual Conference of the Anxiety Disorders Association of America, Santa Ana Pueblo, New Mexico, March 12-15, 2009.

128. **Killgore, WD,** Britton, JC, Price, LM, Gold, AL, Deckersbach, T, & Rauch, SL. Neuroticism is inversely correlated with amygdala and insula activation during masked presentations of affective stimuli. Abstract presented at the Annual Conference of the Anxiety Disorders Association of America, Santa Ana Pueblo, New Mexico, March 12-15, 2009.

129. **Killgore, WD,** Kelley, AM, & Balkin, TJ. Development and validation of a scale to measure the perception of invincibility. Abstract presented at the Annual Conference of the Anxiety Disorders Association of America, Santa Ana Pueblo, New Mexico, March 12-15, 2009.

130. Kelly, AM, **Killgore WD,** Athy, J, & Dretsch, M. Risk propensity, risk perception, risk aversion, and sensation seeking in U.S. Army soldiers. Abstract presented at the 80th Annual Scientific Meeting of the Aerospace Medical Association, Los Angeles, CA, May 3-7, 2009.

131. Britton, JC, Stewart, SE, Price, LM, **Killgore, WD,** Jenike, MA, & Rauch, SL. The neural correlates of negative priming in pediatric obsessive-compulsive disorder (OCD). Abstract presented at the 64th Annual Scientific Meeting of the Society of Biological Psychiatry, Vancouver, Canada, May 14-16, 2009.

132. **Killgore, WD,** Killgore, DB, Kamimori, GH, & Balkin, TJ. Caffeine protects against increased risk-taking behavior during severe sleep deprivation. Abstract presented at the 23rd Annual Meeting of the Associated Professional Sleep Societies, Seattle, Washington, June 7-12, 2009.

133. Killgore, DB, **Killgore, WD,** Grugle, NL, & Balkin, TJ. Executive functions predict the ability to sustain psychomotor vigilance during sleep loss. Abstract presented at the 23rd Annual Meeting of the Associated Professional Sleep Societies, Seattle, Washington, June 7-12, 2009.

134. **Killgore, WD,** & Yurgelun-Todd, DA. Trouble falling asleep is associated with reduced activation of dorsolateral prefrontal cortex during a simple attention task. Abstract presented at the 23rd Annual Meeting of the Associated Professional Sleep Societies, Seattle, Washington, June 7-12, 2009.

135. **Killgore, WD,** Kelley, AM, & Balkin, TJ. A new scale for measuring the perception of invincibility. Abstract presented at the 12th Annual Force Health Protection Conference, Albuquerque, New Mexico, August 14-21, 2009.

136. **Killgore, WD,** Killgore, DB, Grugle, NL, & Balkin, TJ. Executive functions contribute to the ability to resist sleep loss. Abstract presented at the 12th Annual Force Health Protection Conference, Albuquerque, New Mexico, August 14-21, 2009.

137. **Killgore, WD,** Killgore, DB, Kamimori, GH, & Balkin, TJ. Caffeine reduces risk-taking behavior during severe sleep deprivation. Abstract presented at the 12th Annual Force Health Protection Conference, Albuquerque, New Mexico, August 14-21, 2009. ***[*Best Paper: Research]***

138. **Killgore, WD,** Castro, CA, & Hoge, CW. Normative data for the Evaluation of Risks Scale—Bubble Sheet Version (EVAR-B) for large scale surveys of returning combat veterans. Abstract presented at the 12th Annual Force Health Protection Conference, Albuquerque, New Mexico, August 14-21, 2009.

139. **Killgore, WD,** Castro, CA, & Hoge, CW. Combat exposure and post-deployment risky behavior. Abstract presented at the 12th Annual Force Health Protection Conference, Albuquerque, New Mexico, August 14-21, 2009.

140. **Killgore, WD**, Price, LM, Britton, JC, Simon, N, Pollack, MH, Weiner, MR, Schwab, ZJ, Rosso, IM, & Rauch, SL. Paralimbic responses to masked emotional faces in PTSD: Disorder and valence specificity. Abstract presented at the Annual McLean Hospital Research Day, January 29, 2010.

141. **Killgore, WD**, Killgore, DB, Kamimori, GH, & Balkin, TJ. Caffeine minimizes behavioral risk-taking during 75 hours of sleep deprivation. Abstract presented at the 38th Annual Meeting of the International Neuropsychological Society, Acapulco, Mexico, February 3-6, 2010.

142. **Killgore, WD** & Balkin, TJ. Vulnerability to sleep loss is affected by baseline executive function capacity. Abstract presented at the 38th Annual Meeting of the International Neuropsychological Society, Acapulco, Mexico, February 3-6, 2010.

143. **Killgore, WD**, Smith, KL, Reichardt, RM., Killgore, DB, & Balkin, TJ. Intellectual capacity is related to REM sleep following sleep deprivation. Abstract presented at the 38th Annual Meeting of the International Neuropsychological Society, Acapulco, Mexico, February 3-6, 2010.

144. **Killgore, WD** & Yurgelun-Todd, DA. Cerebral correlates of amygdala responses to masked fear, anger, and happiness in adolescent and pre-adolescent children. Abstract presented at the 38th Annual Meeting of the International Neuropsychological Society, Acapulco, Mexico, February 3-6, 2010.

145. **Killgore, WD**, Post, A, & Yurgelun-Todd, DA. Sex differences in cortico-limbic responses to images of high calorie food. Abstract presented at the 38th Annual Meeting of the International Neuropsychological Society, Acapulco, Mexico, February 3-6, 2010.

146. **Killgore, WD** & Yurgelun-Todd, DA. Self-reported insomnia is associated with increased activation within the default-mode network during a simple attention task. Abstract presented at the 38th Annual Meeting of the International Neuropsychological Society, Acapulco, Mexico, February 3-6, 2010.

147. **Killgore, WD**, Price, LM, Britton, JC, Gold, AL, Deckersbach, T, & Rauch, SL. Neural correlates of anxiety sensitivity factors during presentation of masked fearful faces. Abstract presented at the 38th Annual Meeting of the International Neuropsychological Society, Acapulco, Mexico, February 3-6, 2010.

148. **Killgore, WD**, Grugle, NL, Conrad, TA, & Balkin, TJ. Baseline executive function abilities predict risky behavior following sleep deprivation. Abstract presented at the 24th Annual Meeting of the Associated Professional Sleep Societies, San Antonio, Texas, June 5-9, 2010.

149. **Killgore, WD**, Grugle, NL, & Balkin, TJ. Judgment of objective vigilance performance is affected by sleep deprivation and stimulants. Abstract presented at the 24th Annual Meeting of the Associated Professional Sleep Societies, San Antonio, Texas, June 5-9, 2010.

150. Killgore, DB, **Killgore, WD**, Grugle, NL, & Balkin, TJ. Resistance to sleep loss and its relationship to decision making during sleep deprivation. Abstract presented at the 24th Annual Meeting of the Associated Professional Sleep Societies, San Antonio, Texas, June 5-9, 2010.

151. Killgore DB, **Killgore, WD**, Grugle, NL, & Balkin, TJ. Subjective sleepiness and objective performance: Differential effects of stimulants during sleep deprivation. Abstract presented at the 24th Annual Meeting of the Associated Professional Sleep Societies, San Antonio, Texas, June 5-9, 2010.

152. Rupp, TL, **Killgore, WD**, & Balkin, TJ. Vulnerability to sleep deprivation is differentially mediated by social exposure in extraverts vs. introverts. Oral presentation at the "Data Blitz" section at the 24th Annual Meeting of the Associated Professional Sleep Societies, San Antonio, Texas, June 5-9, 2010.

153. Rupp, TL, **Killgore, WD**, & Balkin, TJ. Extraverts may be more vulnerable than introverts to

sleep deprivation on some measures of risk-taking and executive functioning. Abstract presented at the 24th Annual Meeting of the Associated Professional Sleep Societies, San Antonio, Texas, June 5-9, 2010.

154. Rupp, TL, **Killgore, WD**, & Balkin, TJ. Vulnerability to sleep deprivation is differentially mediated by social exposure in extraverts vs. introverts. Abstract presented at the 24th Annual Meeting of the Associated Professional Sleep Societies, San Antonio, Texas, June 5-9, 2010.

155. Capaldi, VF, Guerrero, ML, & **Killgore, WD**. Sleep disorders among OIF and OEF Soldiers. Abstract presented at the 24th Annual Meeting of the Associated Professional Sleep Societies, San Antonio, Texas, June 5-9, 2010.

156. **Killgore, WD**, Killgore, DB, Kamimori, GH, & Balkin, TJ. Caffeine reduces behavioral risk-taking during sleep deprivation. Abstract presented at the 65th Annual Meeting of the Society for Biological Psychiatry, New Orleans, Louisiana, May 20-22, 2010.

157. **Killgore, WD**, Price, LM, Britton, JC, Simon, N, Pollack, MH, Weiner, MR, Schwab, ZJ, Rosso, IM, & Rauch, SL. Paralimbic responses to masked emotional faces in PTSD: Disorder and valence specificity. Abstract presented at the 65th Annual Meeting of the Society for Biological Psychiatry, New Orleans, Louisiana, May 20-22, 2010.

158. Rosso, IM, Makris, N, Britton, JC, Price, LM, Gold, AL, Deckersbach, T, **Killgore, WD**, & Rauch SL. Anxiety sensitivity correlates with insular cortex volume and thickness in specific animal phobia. Abstract presented at the 65th Annual Meeting of the Society for Biological Psychiatry, New Orleans, Louisiana, May 20-22, 2010.

159. Rupp, TL, **Killgore, WD**, & Balkin, TJ. Vulnerability to sleep deprivation is mediated by social exposure in extraverts versus introverts. Oral platform presentation at the 20th Congress of the European Sleep Research Society, Lisbon, Portugal, September 14-18, 2010.

160. **Killgore, WD**, Estrada, A, & Balkin, TJ. A tool for monitoring soldier fatigue and predicting cognitive readiness: The Sleep History and Readiness Predictor (SHARP). Abstract presented at the 27th Army Science Conference, Orlando, FL, November 29-December 2, 2010.

161. **Killgore, WD**, Kamimori, GH, & Balkin, TJ. Caffeinated gum minimizes risk-taking in soldiers during prolonged sleep deprivation. Abstract presented at the 27th Army Science Conference, Orlando, FL, November 29-December 2, 2010.

162. **Killgore, WD**, Britton, JC, Schwab, ZJ, Weiner, MR, Rosso, IM, & Rauch, SL. Exaggerated amygdala responses to masked fearful faces are specific to PTSD versus simple phobia. Oral platform presentation at the 27th Army Science Conference, Orlando, FL, November 29-December 2, 2010. ***[*Winner Best Paper in Neuroscience]***

163. **Killgore, WD**, Kamimori, GH, & Balkin, TJ. Sleep deprivation selectively impairs emotional aspects of cognitive functioning. Oral platform presentation at the 27th Army Science Conference, Orlando, FL, November 29-December 2, 2010.

164. Rupp, TL, **Killgore, WD**, & Balkin, TJ. Evaluation of personality and social exposure as

individual difference factors influencing response to sleep deprivation. Oral platform presentation at the 27th Army Science Conference, Orlando, FL, November 29-December 2, 2010.

165. **Killgore, WD**, Britton, JC, Rosso, IM, Schwab, ZJ, Weiner, MR, & Rauch, SL. Shared and differential patterns of amygdalo-cortical activation across anxiety disorders. Abstract presented at the 49th Annual Meeting of the American College of Neuropsychopharmacology, Miami Beach, FL, December 5-9, 2010.

166. Rosso, IM, **Killgore, WD**, Britton, JC, Weiner, MR, Schwab, ZJ, & Rauch, SL. Neural correlates of PTSD symptom dimensions during emotional processing: A functional magnetic resonance imaging study. Abstract presented at the 49th Annual Meeting of the American College of Neuropsychopharmacology, Miami Beach, FL, December 5-9, 2010.

167. **Killgore, WD,** Rosso, IM, Britton, JC, Schwab, ZJ, Weiner, MR, & Rauch, SL. Cortico-limbic activation differentiates among anxiety disorders with and without a generalized threat response. Abstract presented at the McLean Hospital Research Day, January 13, 2011.

168. Weiner, MR, Schwab, ZJ, Rauch, SL, & **Killgore WD**. Personality factors predict brain responses to images of high-calorie foods. Abstract presented at the McLean Hospital Research Day, January 13, 2011.

169. Schwab, ZJ, Weiner, MR, Rauch, SL, & **Killgore, WD.** Emotional and cognitive intelligence: Support for the neural efficiency hypothesis. Abstract presented at the McLean Hospital Research Day, January 13, 2011.

170. Crowley, DJ, Covell, MJ, **Killgore, WD**, Schwab, ZJ, Weiner, MR, Acharya, D, Rosso, IM, & Silveri, MM. Differential influence of facial expression on inhibitory capacity in adolescents versus adults. Abstract presented at the McLean Hospital Research Day, January 13, 2011.

171. **Killgore, WD**, Britton, JC, Rosso, IM, Schwab, ZJ, Weiner, MR, & Rauch, SL. Similarities and differences in cortico-limbic responses to masked affect probes across anxiety disorders. Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

172. Rosso, IM, **Killgore, WD**, Britton, JC, Weiner, MR, Schwab, ZJ, & Rauch, SL. Hyperarousal and reexperiencing symptoms of post-traumatic stress disorder are differentially associated with limbic-prefrontal brain responses to threatening stimuli. Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

173. Schwab, ZJ, Weiner, MR, Rauch, SL, & **Killgore, WD**. Neural correlates of cognitive and emotional intelligence in adults. Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

174. Schwab, ZJ, Weiner, MR, Rauch, SL, & **Killgore, WD**. Cognitive and emotional intelligences: Are they distinct or related constructs? Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

175. Schwab, ZJ, Weiner, MR, Rauch, SL, & **Killgore, WD**. Discrepancy scores between cognitive and emotional intelligence predict neural responses to affective stimuli. Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

176. **Killgore, WD**, Schwab, ZJ, Weiner, MR, & Rauch, SL. Smart people go with their gut: Emotional intelligence correlates with non-conscious insular responses to facial trustworthiness. Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

177. **Killgore, WD**, Weiner, MR, Schwab, ZJ, & Rauch, SL. Whom can you trust? Neural correlates of subliminal perception of facial trustworthiness. Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

178. Weiner, MR, Schwab, ZJ, & Rauch, SL, **Killgore, WD**. Impulsiveness predicts responses of brain reward circuitry to high-calorie foods. Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

179. Weiner, MR, Schwab, ZJ, & Rauch, SL, **Killgore, WD**. Conscientiousness predicts brain responses to images of high-calorie foods. Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

180. Crowley, DJ, Covell, MJ, **Killgore, WD**, Schwab, ZJ, Weiner, MR, Acharya, D, Rosso, IM, & Silveri, MM. Differential influence of facial expression on inhibitory capacity in adolescents versus adults. Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

181. Gruber, SA, Dahlgren, MK, **Killgore, WD**, Sagar, KA, & Racine, MT. Marijuana: Age of onset of use impacts executive function and brain activation. Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

182. **Killgore, WD,** Conrad, TA, Grugle, NL, & Balkin, TJ. Baseline executive function abilities correlate with risky behavior following sleep deprivation. Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

183. **Killgore, WD,** Grugle, NL, Killgore, DB, & Balkin, TJ. Resistance to sleep loss and decision making during sleep deprivation. Abstract presented at the 39th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 2-5, 2011.

184. **Killgore, WD,** Rosso, IM, Britton, JC, Schwab, ZJ, Weiner, MR, & Rauch, SL. Cortico-limbic activation differentiates among anxiety disorders with and without a generalized threat response. Abstract presented at the 66th Annual Meeting of the Society for Biological Psychiatry, San Francisco, CA, May 12-14, 2011. ***[*Blue Ribbon Finalist: Clinical/Translational]***

185. Schwab, ZJ, Weiner, MR, Rauch, SL, & **Killgore, WD.** Emotional and cognitive intelligence:

Support for the neural efficiency hypothesis. Abstract presented at the 66th Annual Meeting of the Society for Biological Psychiatry, San Francisco, CA, May 12-14, 2011.

186. Weiner, MR, Schwab, ZJ, Rauch, SL, & **Killgore WD**. Personality factors predict brain responses to images of high-calorie foods. Abstract presented at the 66th Annual Meeting of the Society for Biological Psychiatry, San Francisco, CA, May 12-14, 2011.

187. **Killgore, WD,** Grugle, NL, & Balkin, TJ. Sleep deprivation impairs recognition of specific emotions. Abstract presented at the 25th Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 11-15, 2011.

188. **Killgore, WD,** & Balkin, TJ. Does vulnerability to sleep deprivation influence the effectiveness of stimulants on psychomotor vigilance? Abstract presented at the 25th Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 11-15, 2011.

189. Killgore, DB, **Killgore, WD,** Grugle, NJ, & Balkin, TJ. Sleep deprivation impairs recognition of specific emotions. Abstract presented at the 25th Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 11-15, 2011.

190. Weiner, MR, Schwab, ZJ, & **Killgore, WD.** Daytime sleepiness is associated with altered brain activation during visual perception of high-calorie foods: An fMRI study. Abstract presented at the 25th Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 11-15, 2011.

191. Schwab, ZJ, Weiner, MR, & **Killgore, WD.** Functional MRI correlates of morningness-eveningness during visual presentation of high calorie foods. Abstract presented at the 25th Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 11-15, 2011.

192. **Killgore, WD,** Weiner, MR, & Schwab, ZJ. Daytime sleepiness affects prefrontal regulation of food intake. Abstract presented at the McLean Hospital Research Day, January 11, 2012.

193. Kipman, M, Schwab ZJ, Weiner, MR, DelDonno, S, Rauch SL, & **Killgore WD**. The insightful yet bitter comedian: The role of emotional versus cognitive intelligence in humor appreciation. Abstract presented at the McLean Hospital Research Day, January 11, 2012.

194. Weber, M, & **Killgore, WD**. Gray matter correlates of emotional intelligence. Abstract presented at the McLean Hospital Research Day, January 11, 2012.

195. Schwab, ZJ, & **Killgore, WD**. Sex differences in functional brain responses to food. Abstract presented at the McLean Hospital Research Day, January 11, 2012.

196. DelDonno, S, Schwab, ZJ, Kipman M, Rauch, SL, & **Killgore, WD**. The influence of cognitive and emotional intelligence on performance on the Iowa Gambling Task. Abstract presented at the McLean Hospital Research Day, January 11, 2012.

197. Song, CH, Kizielewicz, J, Schwab, ZJ, Weiner, MR, Rauch, SL, & **Killgore, WD**. Time is of the essence: The Design Organization Test as a valid, reliable, and brief measure of visuospatial

ability. Abstract presented at the 40th Annual Meeting of the International Neuropsychological Society, Montreal, CA, February 15-18, 2012.

198. Kipman, M, Schwab, ZJ, DelDonno, S, & **Killgore, WD**. Gender differences in the contribution of cognitive and emotional intelligence to the left visual field bias for facial perception. Abstract presented at the 40th Annual Meeting of the International Neuropsychological Society, Montreal, CA, February 15-18, 2012.

199. Kipman, M., Schwab, ZJ, Weiner, MR, DelDonno, S, Rauch, SL, & **Killgore, WD**. Contributions of emotional versus cognitive intelligence in humor appreciation. Abstract presented at the 40th Annual Meeting of the International Neuropsychological Society, Montreal, CA, February 15-18, 2012.

200. Schwab, ZJ, & **Killgore, WD**. Disentangling emotional and cognitive intelligence. Abstract presented at the 40th Annual Meeting of the International Neuropsychological Society, Montreal, CA, February 15-18, 2012.

201. Schwab, ZJ, & **Killgore, WD**. Sex differences in functional brain responses to food. Abstract presented at the 40th Annual Meeting of the International Neuropsychological Society, Montreal, CA, February 15-18, 2012.

202. DelDonno, S, Schwab, ZJ, Kipman, M, Rauch, SL, & **Killgore, WD**. The influence of cognitive and emotional intelligence on performance on the Iowa Gambling Task. Abstract presented at the 40th Annual Meeting of the International Neuropsychological Society, Montreal, CA, February 15-18, 2012.

203. **Killgore, WD**, Britton, JC, Rosso, IM, Schwab, ZJ, Weiner, MR, & Rauch, SL. Shared and unique patterns of cortico-limbic activation across anxiety disorders. Abstract presented at the 40th Annual Meeting of the International Neuropsychological Society, Montreal, CA, February 15-18, 2012.

204. **Killgore, WD**, & Balkin, TJ. Sleep deprivation degrades recognition of specific emotions. Abstract presented at the 40th Annual Meeting of the International Neuropsychological Society, Montreal, CA, February 15-18, 2012.

205. **Killgore, WD**, & Schwab, ZJ. Emotional intelligence correlates with somatic marker circuitry responses to subliminal cues of facial trustworthiness. Abstract presented at the 40th Annual Meeting of the International Neuropsychological Society, Montreal, CA, February 15-18, 2012.

206. **Killgore, WD**, & Schwab, ZJ. Trust me! Neural correlates of the ability to identify facial trustworthiness. Abstract presented at the 40th Annual Meeting of the International Neuropsychological Society, Montreal, CA, February 15-18, 2012.

207. **Killgore, WD**, Schwab, ZJ, Weiner, MR, Kipman, M, DelDonno, S, & Rauch SL. Overeating is associated with altered cortico-limbic responses to images of high calorie foods. Abstract presented at the 40th Annual Meeting of the International Neuropsychological Society, Montreal, CA, February 15-18, 2012.

208. **Killgore, WD**, Weiner, MR, & Schwab, ZJ. Daytime sleepiness affects prefrontal regulation of food intake. Abstract presented at the 40th Annual Meeting of the International Neuropsychological Society, Montreal, CA, February 15-18, 2012.

209. Weber, M, DelDonno, S, Kipman M, Schwab, ZJ, & **Killgore WD**. Grey matter correlates of self-reported sleep duration. Abstract presented at the Harvard Medical School Research Day, Boston, MA, March 28, 2012.

210. **Killgore, WD**. Overlapping and distinct patterns of neurocircuitry across PTSD, Panic Disorder, and Simple Phobia. Abstract presented at the 32nd Annual Conference of the Anxiety Disorders Association of America, Arlington, VA, April 12-15, 2012.

211. **Killgore, WD**, Britton, JC, Rosso, IM, Schwab, ZJ, & Rauch, SL. Shared and unique patterns of cortico-limbic activation across anxiety disorders. Abstract presented at the 67th Annual Meeting of the Society of Biological Psychiatry, Philadelphia, PA, May 3-5, 2012.

212. **Killgore, WD**, Schwab, ZJ, & Rauch, SL. Daytime sleepiness affects prefrontal inhibition of food consumption. Abstract presented at the 67th Annual Meeting of the Society of Biological Psychiatry, Philadelphia, PA, May 3-5, 2012.

213. Rosso, IM, Britton, JC, Makris, N, **Killgore, WD**, Rauch SL, & Stewart ES. Impact of major depression comorbidity on prefrontal and anterior cingulate volumes in pediatric OCD. Abstract presented at the 67th Annual Meeting of the Society of Biological Psychiatry, Philadelphia, PA, May 3-5, 2012.

214. Kipman, M, Weber, M, DelDonno, S., Schwab, ZJ, & **Killgore, WD**. Morningness-Eveningness correlates with orbitofrontal gray matter volume. Abstract presented at the 26th Annual Meeting of the Associated Professional Sleep Societies, Boston, MA, June 9-13, 2012.

215. Kipman, M, Schwab, ZJ, Weber, M, DelDonno, S, & **Killgore, WD**. Yawning frequency is correlated with reduced medial thalamic volume. Abstract presented at the 26th Annual Meeting of the Associated Professional Sleep Societies, Boston, MA, June 9-13, 2012.

216. Weber, M, DelDonno, S, Kipman M, Schwab, ZJ, & **Killgore WD**. Grey matter correlates of daytime sleepiness. Abstract presented at the 26th Annual Meeting of the Associated Professional Sleep Societies, Boston, MA, June 9-13, 2012.

217. Weber, M, DelDonno, S, Kipman M, Schwab, ZJ, & **Killgore WD**. Grey matter correlates of self-reported sleep duration. Abstract presented at the 26th Annual Meeting of the Associated Professional Sleep Societies, Boston, MA, June 9-13, 2012.

218. DelDonno, S, Weber, M, Kipman M, Schwab, ZJ, & **Killgore, WD**. Resistance to insufficient sleep correlates with olfactory cortex gray matter. Abstract presented at the 26th Annual Meeting of the Associated Professional Sleep Societies, Boston, MA, June 9-13, 2012.

219. DelDonno, S, Schwab, ZJ, Kipman, M, Weber, M, & **Killgore, WD**. Weekend sleep is related to greater coping and resilience capacities. Abstract presented at the 26th Annual Meeting of the

Associated Professional Sleep Societies, Boston, MA, June 9-13, 2012.

220. Schwab, ZJ, DelDonno, S, Weber, M, Kipman M, & **Killgore, WD**. Habitual caffeine consumption and cerebral gray matter volume. Abstract presented at the 26th Annual Meeting of the Associated Professional Sleep Societies, Boston, MA, June 9-13, 2012.

221. Schwab, ZJ, & **Killgore, WD**. Daytime sleepiness affects prefrontal regulation of food intake. Abstract presented at the 26th Annual Meeting of the Associated Professional Sleep Societies, Boston, MA, June 9-13, 2012.

222. **Killgore, WD**, Schwab, ZJ, DelDonno S, Kipman, M, Weber M, & Rauch, SL. Greater nocturnal sleep time is associated with increased default mode functional connectivity. Abstract presented at the 26th Annual Meeting of the Associated Professional Sleep Societies, Boston, MA, June 9-13, 2012.

223. **Killgore, WD**, Kamimori, GH, & Balkin, TJ. Caffeine improves efficiency of planning and sequencing abilities during sleep deprivation. Abstract presented at the 26th Annual Meeting of the Associated Professional Sleep Societies, Boston, MA, June 9-13, 2012.

224. Sneider, JT, **Killgore, WD**, Crowley, DJ, Cohen-Gilbert, JE, Schwab, ZJ, & Silveri, MM. Inhibitory capacity in emerging adult binge drinkers: Influence of Facial Cues. Abstract presented at the 35th Annual Scientific Meeting of the Research Society on Alcoholism, San Francisco, CA, June 23-27, 2012.

225. **Killgore WD**. Multimodal neuroimaging to predict cognitive resilience against sleep loss. Abstract presented at the DARPA Young Faculty Award 2012 Meeting, Arlington, VA, July 30-31, 2012. ***[*Winner Young Faculty Award in Neuroscience]***

226. Cohen-Gilbert, JE, **Killgore WD**, Crowley, DJ, Covell, MJ, Schwab, ZJ, Weiner, MR, Acharya, D, Sneider, JT, & Silveri, MM. Differential influence of safe versus threatening facial expressions on inhibitory control across adolescence and adulthood. Abstract presented at the Society for Neuroscience 2012 Meeting, New Orleans, LA, October 13-17, 2012.

227. Weber, M, DelDonno, S, Kipman M, Schwab, ZJ, & **Killgore WD**. Grey matter correlates of self-reported sleep duration. Abstract presented at the Harvard Division of Sleep Medicine Annual Poster Session, Boston, MA, September 27, 2012.

228. Weber, M, DelDonno, SR, Kipman, M, Preer, LA, Schwab ZJ, Weiner, MR, & **Killgore, WD.** The effect of morning bight light therapy on sleep, cognition and emotion following mild traumatic brain injury. Abstract presented at the 2012 Sleep Research Network Meeting, 22-23 October 2012, Bethesda, MD.

229. Sneider, JT, **Killgore, WD**, Crowley, DJ, Cohen-Gilbert, JE, Schwab, ZJ, & Silveri, MM. Inhibitory capacity in emerging adult binge drinkers: Influence of Facial Cues. Abstract presented at the Annual McLean Hospital Research Day, January 16, 2013.

230. Cohen-Gilbert, JE, **Killgore WD**, Crowley, DJ, Covell, MJ, Schwab, ZJ, Weiner, MR, Acharya, D, Sneider, JT, & Silveri, MM. Differential influence of safe versus threatening facial

expressions on inhibitory control across adolescence and adulthood. Abstract presented at the Annual McLean Hospital Research Day, January 16, 2013.

231. Tkachenko, O, Schwab, ZJ, Kipman, M, DelDonno, S, Gogel, H., Preer, L, & **Killgore, WD**. Smarter women need less sleep. Abstract presented at the Annual McLean Hospital Research Day, January 16, 2013.

232. DelDonno, S, Kipman, M, Schwab, ZJ, & **Killgore, WD**. The contributions of emotional intelligence and facial perception to social intuition. Abstract presented at the Annual McLean Hospital Research Day, January 16, 2013.

233. Kipman, M, Schwab, ZJ, DelDonno, S, Weber, M, Rauch, SL, & **Killgore, WD**. The neurocircuitry of impulsive behavior. Abstract presented at the Annual McLean Hospital Research Day, January 16, 2013.

234. Preer, LA, Tkachenko, O, Gogel, H, Schwab, ZJ, Kipman, M, DelDonno, SR, Weber, M, Webb, CA, & **Killgore, WD**. Emotional intelligence as a mediator of the association between anxiety sensitivity and anxiety symptoms. Abstract presented at the Annual McLean Hospital Research Day, January 16, 2013.

235. Gogel, H, DelDonno, S, Kipman M, Preer, LA, Schwab, ZJ, Tkachenko, O, & **Killgore, WD**. Validation of the Design Organization Test (DOT) in a healthy population. Abstract presented at the Annual McLean Hospital Research Day, January 16, 2013.

236. Brennan, BP, Schwab, ZS, Athey, AJ, Ryan, EM, Pope, HG, **Killgore, WD**, Jenike, MA, & Rauch, SL. A functional magnetic resonance imaging study of rostral anterior cingulate cortex activation in obsessive-compulsive disorder using an emotional counting stroop paradigm. Abstract presented at the Annual McLean Hospital Research Day, January 16, 2013.

237. Cohen-Gilbert, JE, Schwab, ZJ, **Killgore, WD**, Crowley, DJ, & Silveri MM. Influence of Binge Drinking on the Neural Correlates of Inhibitory Control during Emotional Distraction in Young Adults. Abstract presented at the 3rd International Conference on Applications of Neuroimaging to Alcoholism (ICANA-3), New Haven, CT, February 15-18, 2013.

238. Weber, M, & **Killgore, WD**. The interrelationship between 'sleep credit', emotional intelligence and mental health – a voxel-based morphometric study. Abstract presented at Harvard Medical School Psychiatry Research Day, April 10, 2013.

239. Cohen-Gilbert, JE, Schwab, ZJ, **Killgore, WD**, Crowley, DJ, & Silveri MM. Influence of Binge Drinking on the Neural Correlates of Inhibitory Control during Emotional Distraction in Young Adults. Abstract presented at Harvard Medical School Psychiatry Research Day, April 10, 2013.

240. Mundy, EA, Weber, M, Rauch, SL, **Killgore, WD**, & Rosso, IM. The relationship between subjective stress levels in childhood and anxiety as well as perceived stress as an adult. Abstract presented at Harvard Medical School Psychiatry Research Day, April 10, 2013.

241. Webb, CA, **Killgore, WD**, Britton, JC, Schwab, ZJ, Price, LM, Weiner, MR, Gold, AL, Rosso,

IM, Simon, NM, Pollack, MH, & Rauch, SL. Comparing categorical versus dimensional predictors of functional response across three anxiety disorders. Abstract presented at the 68th Annual Meeting of the Society of Biological Psychiatry, San Francisco, CA, May 16-18, 2013.

242. Preer, LA, Tkachenko, O, Gogel, H, Schwab, ZJ, Kipman, M, DelDonno, SR, Weber, M, Webb, CA, Rauch, SL, & **Killgore, WD**. Linking Sleep Trouble to Neuroticism, Emotional Control, and Impulsiveness. Abstract presented at the 68th Annual Meeting of the Society of Biological Psychiatry, San Francisco, CA, May 16-18, 2013.

243. Preer, LA, Tkachenko, O, Gogel, H, Schwab, ZJ, Kipman, M, DelDonno, SR, Weber, M, Webb, CA, Rauch, SL, & **Killgore, WD**. Emotional Intelligence as a Mediator of the Association between Anxiety Sensitivity and Anxiety Symptoms. Abstract presented at the 68th Annual Meeting of the Society of Biological Psychiatry, San Francisco, CA, May 16-18, 2013.

244. Kipman, M, Schwab, ZJ, DelDonno, S, Weber, M, Rauch, SL, & **Killgore, WD**. The neurocircuitry of impulsive behavior. Abstract presented at the 68th Annual Meeting of the Society of Biological Psychiatry, San Francisco, CA, May 16-18, 2013.

245. Weber, M, **Killgore, WD**, Rosso, IM, Britton, JC, Simon, NM, Pollack, MH, & Rauch, SL. Gray matter correlates of posttraumatic stress disorder—A voxel based morphometry study. Abstract presented at the 68th Annual Meeting of the Society of Biological Psychiatry, San Francisco, CA, May 16-18, 2013.

246. Weber, M, Penetar, DM, Trksak, GH, DelDonno, SR, Kipman, M, Schwab, ZJ, & **Killgore, WD**. Morning blue wavelength light therapy improves sleep, cognition, emotion and brain function following mild traumatic brain injury. Abstract presented at the 68th Annual Meeting of the Society of Biological Psychiatry, San Francisco, CA, May 16-18, 2013.

247. Tkachenko, O, Schwab, ZJ, Kipman, M, Preer, LA, Gogel, H, DelDonno, SR, Weber, M, Webb, CA, Rauch, SL, & **Killgore, WD**. Difficulty in falling asleep and staying asleep linked to a sub-clinical increase in symptoms of psychopathology. Abstract presented at the 68th Annual Meeting of the Society of Biological Psychiatry, San Francisco, CA, May 16-18, 2013.

248. **Killgore, WD**, Schwab, ZJ, Kipman, M, DelDonno, SR, Rauch, SL, & Weber, M. Problems with sleep initiation and sleep maintenance correlate with functional connectivity among primary sensory cortices. Abstract presented at the 68th Annual Meeting of the Society of Biological Psychiatry, San Francisco, CA, May 16-18, 2013.

249. **Killgore, WD**, Schwab, ZJ, Kipman, M, DelDonno, SR, Rauch, SL, & Weber, M. A Couple of Hours Can Make a Difference: Self-Reported Sleep Correlates with Prefrontal-Amygdala Connectivity and Emotional Functioning. Abstract presented at the 68th Annual Meeting of the Society of Biological Psychiatry, San Francisco, CA, May 16-18, 2013.

250. Brennan, BP, Schwab, ZS, Athey, AJ, Ryan, EM, Pope, HG, **Killgore, WD**, Jenike, MA, & Rauch, SL. A functional magnetic resonance imaging study of rostral anterior cingulate cortex activation in obsessive-compulsive disorder using an emotional counting stroop paradigm. Abstract presented at the 68th Annual Meeting of the Society of Biological Psychiatry, San Francisco, CA, May 16-18, 2013.

251. Weber, M, & **Killgore, WD**. The interrelationship between 'sleep credit', emotional intelligence and mental health – a voxel-based morphometric study. Abstract presented at the SLEEP 2013 Annual Meeting, Baltimore, MD, June 1-5, 2013.

252. Weber, M, Penetar, DM, Trksak, GH, DelDonno, SR, Kipman, M, Schwab, ZJ, & **Killgore, WD**. Morning blue wavelength light therapy improves sleep, cognition, emotion and brain function following mild traumatic brain injury. Abstract presented at the SLEEP 2013 Annual Meeting, Baltimore, MD, June 1-5, 2013.

253. **Killgore, WD**, Schwab, ZJ, Kipman, M, DelDonno, SR, & Weber, M. Problems with Sleep Initiation and Sleep Maintenance Correlate with Functional Connectivity Among Primary Sensory Cortices. Abstract presented at the SLEEP 2013 Annual Meeting, Baltimore, MD, June 1-5, 2013.

254. **Killgore, WD**, Schwab, ZJ, Kipman, M, DelDonno, SR, & Weber, M. A Couple of Hours Can Make a Difference: Self-Reported Sleep Correlates with Prefrontal-Amygdala Connectivity and Emotional Functioning. Abstract presented at the SLEEP 2013 Annual Meeting, Baltimore, MD, June 1-5, 2013.

255. Tkachenko, O, Schwab, ZJ, Kipman, M, DelDonno, SR, Preer, LA, Gogel, H, Weber, M, Webb, CA, & **Killgore, WD**. Difficulty in falling asleep and staying asleep linked to a sub-clinical increase in symptoms of psychopathology. Abstract presented at the SLEEP 2013 Annual Meeting, Baltimore, MD, June 1-5, 2013.

256. Preer, LA, Tkachenko, O, Gogel, H, Schwab, ZJ, Kipman, M, DelDonno, SR, Weber, M, Webb, CA, & **Killgore, WD**. Linking Sleep Initiation Trouble to Neuroticism, Emotional Control, and Impulsiveness. Abstract presented at the SLEEP 2013 Annual Meeting, Baltimore, MD, June 1-5, 2013.

257. **Killgore, WD**. Sleep duration contributes to cortico-limbic functional connectivity, emotional functioning, & psychological health. Abstract presented at the 52nd Annual Meeting of the American College of Neuropsychopharmacology, Hollywood, FL, December 8-12, 2013.

258. Preer, L, Tkachenko, O, Gogel, H, Bark, JS, Kipman, M, Olson, EA, & **Killgore, WD**. The role of personality in sleep initiation problems. Abstract presented at the Annual McLean Hospital Research Day, January 22, 2014.

259. Demers, LA, Olson, EA, Weber, M, Divatia, S, Preer, L, & **Killgore, WD**. Paranoid traits are related to deficits in complex social decision-making and reduced superior temporal sulcus volume. Abstract presented at the Annual McLean Hospital Research Day, January 22, 2014.

260. Tkachenko, O, Weber, M, Gogel, H, & **Killgore, WD**. Predisposition towards unhealthy foods linked with increased gray matter in the cerebellum. Abstract presented at the Annual McLean Hospital Research Day, January 22, 2014.

261. Olson, EA, Weber, M, Tkachenko, O, & **Killgore, WD**. Daytime sleepiness is associated with decreased integration of remote outcomes on the IGT. Abstract presented at the Annual

McLean Hospital Research Day, January 22, 2014.

262. Cui, J, Tkachenko, O, & **Killgore, WD**. Can the activation of anterior cingulate predict the emotional suppression? An fMRI study with masked faces. Abstract presented at the Annual McLean Hospital Research Day, January 22, 2014.

263. Gogel, H, & **Killgore WDS**. A psychometric validation of the Design Organization Test (DOT) in a healthy sample. Abstract presented at the 42nd Annual Meeting of the International Neuropsychological Society, Seattle WA, February 12-15, 2014.

264. **Killgore, WD**, Kipman, M, Tkachenko, O, Gogel, H., Preer, L, Demers, LA, Divatia, SC, Olson, EA, & Weber, M. Predicting resilience against sleep loss with multi-modal neuroimaging. Abstract presented at the 42nd Annual Meeting of the International Neuropsychological Society, Seattle WA, February 12-15, 2014.

265. **Killgore, WD**, Weber, M, Bark, JS, Kipman, M, Gogel, H, Preer, L, Tkachenko, O, Demers, LA, Divatia, SC, & Olson, EA. Physical exercise correlates with hippocampal volume in healthy adults. Abstract presented at the 42nd Annual Meeting of the International Neuropsychological Society, Seattle WA, February 12-15, 2014.

266. **Killgore, WD**, Tkachenko, O, Weber, M, Kipman, M, Preer, L, Gogel, H, & Olson, EA. The association between sleep, functional connectivity, and emotional functioning. Abstract presented at the 42nd Annual Meeting of the International Neuropsychological Society, Seattle WA, February 12-15, 2014.

267. Preer, L, Tkachenko, O, Gogel, H, Bark, JS, Kipman, M, Olson, EA, & **Killgore, WD**. The role of personality in sleep initiation problems. Abstract presented at the 42nd Annual Meeting of the International Neuropsychological Society, Seattle WA, February 12-15, 2014.

268. Tkachenko, O, Weber, M, Olson, EA, Gogel, H, Preer, LA, Divatia, SC, Demers, LA, & **Killgore, WD**. Gray matter volume within the medial prefrontal cortex correlates with behavioral risk taking. Abstract presented at the 42nd Annual Meeting of the International Neuropsychological Society, Seattle WA, February 12-15, 2014.

269. Olson, EA, Weber, M, Bark JS, Demers L, Divatia, SC, Gogel, H, Kipman M, Preer, L, Tkachenko, O, & **Killgore, WD**. Sex differences in threat evaluation of emotionally neutral faces. Abstract presented at the 42nd Annual Meeting of the International Neuropsychological Society, Seattle WA, February 12-15, 2014.

270. Cui, J, Tkachenko, O, & **Killgore, WD**. Can the activation of anterior cingulate predict the emotional suppression? An fMRI study with masked faces. Abstract presented at the 36nd Annual Conference of the Anxiety Disorders Association of America, Chicago, IL, March 27-30, 2014.

271. Webb, CA, Weber, M, Mundy, EA, & **Killgore, WD**. Reduced gray matter volume in the anterior cingulate, orbitofrontal cortex and thalamus as a function of depressive symptoms: A voxel-based morphometric analysis. Abstract presented at the 36nd Annual Conference of the Anxiety Disorders Association of America, Chicago, IL, March 27-30, 2014.

272. Weber, M, Penetar, DM, Trksak, GH, Kipman, M, Tkachenko, O, Bark, JS, Jorgensen, AL, Rauch, SL, & **Killgore, WD**. Light therapy may improve sleep and facilitate recovery from mild traumatic brain injury. Abstract presented at the 10th World Congress on Brain Injury, San Francisco, CA, March 19-22, 2014.

273. Cui, J, Tkachenko, O, & **Killgore, WD**. Can the activation of anterior cingulate predict the emotional suppression? An fMRI study with masked faces. Abstract presented at the 21st Annual Meeting of the Cognitive Neuroscience Society, Boston, MA, April 5-8, 2014.

274. Divatia, S, Demers, LA, Preer, L, Olson, EA, Weber, M, & **Killgore, WD**. Advantageous decision making linked with increased gray matter volume in the ventromedial prefrontal cortex. Abstract presented at the 21st Annual Meeting of the Cognitive Neuroscience Society, Boston, MA, April 5-8, 2014.

275. Demers, LA, Olson, EA, Weber, M, Divatia, S, Preer, L, & **Killgore, WD**. Paranoid traits are related to deficits in complex social decision making and reduced superior temporal sulcus volume. Abstract presented at the 21st Annual Meeting of the Cognitive Neuroscience Society, Boston, MA, April 5-8, 2014.

276. Preer, LA, Weber, M, Tkachenko, O, Divatia, S, Demers, LA, Olson, EA, & **Killgore, WD**. Gray matter volume in the amygdala is associated with facial assessments of trustworthiness. Abstract presented at the 21st Annual Meeting of the Cognitive Neuroscience Society, Boston, MA, April 5-8, 2014.

277. Tkachenko, O, Weber, M, Gogel, H, & **Killgore, WD**. Predisposition towards unhealthy foods linked with increased gray matter volume in the cerebellum. Abstract presented at the 21st Annual Meeting of the Cognitive Neuroscience Society, Boston, MA, April 5-8, 2014.

278. Olson, EA, Weber, M, Gogel, H, & **Killgore, WD**. Daytime sleepiness is associated with decreased integration of remote outcomes on the IGT. Abstract presented at the 21st Annual Meeting of the Cognitive Neuroscience Society, Boston, MA, April 5-8, 2014.

279. Demers, LA, Preer, LA, Gogel, H, Olson, EA, Weber, M, & **Killgore, WD**. Left-hemifield bias on sad chimeric face task correlates with interpersonal emotional intelligence. Abstract presented at the 69th Annual Meeting of the Society of Biological Psychiatry, New York, NY, May 8-10, 2014.

280. Weber, M, **Killgore, WD**, Olson, EA, Rosso, IM, & Rauch, SL. Morphological brain network organization in relation to trauma and posttraumatic stress disorder. Abstract presented at the 69th Annual Meeting of the Society of Biological Psychiatry, New York, NY, May 8-10, 2014.

281. Divatia, S, Demers, LA, Preer, L, Gogel, H, Kipman, M, & **Killgore, WD**. Schizotypal and manic traits are associated with poorer perception of emotions in healthy individuals. Abstract presented at the 69th Annual Meeting of the Society of Biological Psychiatry, New York, NY, May 8-10, 2014.

282. **Killgore, WD**, Weber, M, Olson, EA, & Rauch, SL. Sleep reduction and functioning of the emotion regulation circuitry. Abstract presented at the 69th Annual Meeting of the Society of Biological Psychiatry, New York, NY, May 8-10, 2014. ***[*Blue Ribbon Finalist for Top Poster Award: Basic Neuroscience]***

283. Webb, CA, Weber, M, Mundy, EA, & **Killgore, WD**. Reduced gray matter volume in the anterior cingulate, orbitofrontal cortex and thalamus as a function of depressive symptoms: A voxel-based morphometric analysis. Abstract presented at the 69th Annual Meeting of the Society of Biological Psychiatry, New York, NY, May 8-10, 2014.

284. Marin MF, Song H, Landau AJ, Lasko NB, Foy Preer LA, Campbell A, Pace-Schott EF, **Killgore WD**, Orr SP, Pitman RK, Simon NM, Milad MR (2014). Psychophysiological and Neuroimaging Correlates of Fear Extinction Deficits Across Anxiety Disorders. Abstract presented at the 69th Annual Meeting of the Society of Biological Psychiatry, New York, NY, May 8-10, 2014.

285. **Killgore, WD**. The effects of sleep loss on food preference. Abstract presented at SLEEP 2014, Minneapolis, MN, May 31-June 4, 2014.

286. Weber, M, & **Killgore, WD**. Sleep habits reflect in functional brain network organization. Abstract presented at SLEEP 2014, Minneapolis, MN, May 31-June 4, 2014. ***[*2014 AASM Young Investigator Award, Honorable Mention]***

287. Freed, MC, Novak, LA, **Killgore, WD**, Koehlmoos, TP, Ginsberg, JP, Krupnick, J, Rauch S, Rizzo, A, Engle, CC. DoD IRB delays: Do they really matter? And if so, why and for whom? Abstract presented at the Military Health System Research Symposium, Fort Lauderdale, FL, August 18-21, 2014.

288. Freed, MC, Novak, LA, **Killgore, WD**, Koehlmoos, TP, Ginsberg, JP, Krupnick, J, Rauch S, Rizzo, A, Engle, CC. DoD IRB delays: Do they really matter? And if so, why and for whom? Abstract presented at the AMSUS Annual Meeting, Washington DC, December 2-5, 2014.

289. **Killgore, WD**, Demers, LA, Olson, EA, Rosso, IM, Webb, CA, & Rauch, SL. Anterior cingulate gyrus and sulcus thickness: A potential predictor of remission following internet-based cognitive behavioral therapy for major depressive disorder. Abstract presented at the 53rd Annual Meeting of the American College of Neuropsychopharmacology, Phoenix, AZ, December 7-11, 2014.

290. Olson, EA, Buchholz, J, Rosso, IM, **Killgore, WD**, Webb, CA, Gogel, H, & Rauch, SL. Internet-based cognitive behavioral therapy effects on symptom severity in major depressive disorder: preliminary results from a randomized controlled trial. Abstract presented at the 53rd Annual Meeting of the American College of Neuropsychopharmacology, Phoenix, AZ, December 7-11, 2014.

291. Brennan, B, Tkachenko, O, Schwab, Z, Ryan, E, Athey, A, Pope, H, Dougherty, D, Jenike, M, **Killgore, WD**, Hudson, J, Jensen, E, & Rauch SL. Abstract presented at the 53rd Annual Meeting of the American College of Neuropsychopharmacology, Phoenix, AZ, December 7-11, 2014.

292. Alkozei, A, Pisner, D, & **Killgore, WD**. Emotional intelligence is differentially correlated with prefrontal cortical responses to backward masked fearful and angry faces. Abstract presented at the 43rd Annual Meeting of the International Neuropsychological Society, Denver, CO, February 4-7, 2015.

293. Alkozei, A, Schwab, Z, & **Killgore, WD**. Looking for evil intent: Emotional intelligence and the use of socially relevant facial cues during an emotional decision making task. Abstract presented at the 43rd Annual Meeting of the International Neuropsychological Society, Denver, CO, February 4-7, 2015.

294. Shane, BR, Alkozei, A, & **Killgore, WD**. The contribution of general intelligence and emotional intelligence to the ability to appreciate humor. Abstract presented at the 43rd Annual Meeting of the International Neuropsychological Society, Denver, CO, February 4-7, 2015.

295. Markowski, SM, Alkozei, A, & **Killgore, WD**. Sleep onset latency and duration are associated with self-perceived invincibility. Abstract presented at the 43rd Annual Meeting of the International Neuropsychological Society, Denver, CO, February 4-7, 2015.

296. Pisner, D, Alkozei, A, & **Killgore, WD**. Visuospatial reasoning mediates the relationship between emotion recognition and emotional intelligence. Abstract presented at the 43rd Annual Meeting of the International Neuropsychological Society, Denver, CO, February 4-7, 2015.

297. Vanuk, JR, Fridman, A, Demers, LA, Divatia, S, & **Killgore, WD**. Engaging in meditation and internet based training as a means of enhancing emotional intelligence. Abstract presented at the 43rd Annual Meeting of the International Neuropsychological Society, Denver, CO, February 4-7, 2015.

298. Vanuk, JR, Divatia, S, Demers, LA, Markowski, SM, & **Killgore, WD**. Napping in conjunction with brief internet-based training as a means of enhancing emotional intelligence. Abstract presented at the 43rd Annual Meeting of the International Neuropsychological Society, Denver, CO, February 4-7, 2015.

299. Cui, J, Tkachenko, O, Gogel, H, Kipman, M, Preer, LA, Weber, M, Divatia, SC, Demers, LA, Olson, EA, Buchholz, JL, Bark, JS, Rosso, IM, Rauch, SL, & **Killgore, WD**. Fractional Anisotropy of frontoparietal connections presicts individual resistance to sleep deprivation. Abstract presented at the 43rd Annual Meeting of the International Neuropsychological Society, Denver, CO, February 4-7, 2015.

300. **Killgore, WD**, Olson, EA, Weber, M, Rauch, SL, & Nickerson, LD. Emotional intelligence is associated with coordinated resting state activity between emotion regulation and interoceptive experience networks. Abstract presented at the 43rd Annual Meeting of the International Neuropsychological Society, Denver, CO, February 4-7, 2015.

301. **Killgore, WD**, Demers, LA, Divatia, S, Kipman, M, Tkachenko, O, Weber, M, Preer, LA, Gogel, H, Olson, EA, Vanuk, JR, & Rauch, SL. Enhancing emotional intelligence via brief internet-based training. Abstract presented at the 43rd Annual Meeting of the International

Neuropsychological Society, Denver, CO, February 4-7, 2015.

302. Buchholz, JL, Rosso, IM, Olson, EA, **Killgore, WD**, Fukunaga, R, Webb, CA, & Rauch, SL. Internet-based cognitive behavioral therapy is associated with symptom reduction and cognitive restructuring in adults with major depressive disorder. Abstract presented at the Anxiety and Depression Conference, Miami, FL, April 9-12, 2015.

303. Alkozei, A, Pisner, D, Rauch, SL, & **Killgore, WD**. Emotional intelligence and subliminal presentations of social threat. Abstract presented at the 70th Annual Meeting of the Society of Biological Psychiatry, Toronto, Ontario, CA, May 14-16, 2015.

304. Shane, BR, Alkozei, A, Vanuk, JR, Weber, M, & **Killgore, WD**. The effect of bright light therapy for improving sleep among individuals with mild traumatic brain injury. Abstract presented at the 70th Annual Meeting of the Society of Biological Psychiatry, Toronto, Ontario, CA, May 14-16, 2015.

305. Vanuk, JR, Shane, BR, Alkozei, A, & **Killgore, WD**. Trait emotional intelligence is associated with greater resting state functional connectivity within the default mode and task positive networks. Abstract presented at the 70th Annual Meeting of the Society of Biological Psychiatry, Toronto, Ontario, CA, May 14-16, 2015.

306. Vanuk, JR, Fridman, A, Demers, LA, & **Killgore, WD**. Engaging in meditation and internet-based training as a means of enhancing emotional intelligence. Abstract presented at the 70th Annual Meeting of the Society of Biological Psychiatry, Toronto, Ontario, CA, May 14-16, 2015.

307. Pisner, D, Alkozei, A, & **Killgore, WD**. Trait emotional suppression is associated with decreased activation of the insula and thalamus in response to masked angry faces. Abstract presented at the 70th Annual Meeting of the Society of Biological Psychiatry, Toronto, Ontario, CA, May 14-16, 2015.

308. Markowski, SM, Alkozei, A, & **Killgore, WD**. The trait of neuroticism predicts neurocognitive performance in healthy individuals. Abstract presented at the 70th Annual Meeting of the Society of Biological Psychiatry, Toronto, Ontario, CA, May 14-16, 2015.

309. Buchholz, JL, Rosso, IM, **Killgore, WD**, Fukunaga, R, Olson, EA, Demers, LA, & Rauch, SL. Amygdala volume is associated with helplessness in adults with major depressive disorder (MDD). Abstract presented at the 70th Annual Meeting of the Society of Biological Psychiatry, Toronto, Ontario, CA, May 14-16, 2015.

310. Sneider, JT, **Killgore, WD**, Rauch, SL, Jensen, JE, & Silveri, MM. Sex differences in the associations between prefrontal GABA and resistance to sleep deprivation. Abstract presented at the 70th Annual Meeting of the Society of Biological Psychiatry, Toronto, Ontario, CA, May 14-16, 2015.

311. **Killgore, WD**, Rosso, IM, Rauch, SL, & Nickerson, LD. Emotional intelligence correlates with coordinated resting state activity between brain networks involved in emotion regulation and interoceptive experience. Abstract presented at the 70th Annual Meeting of the Society of

Biological Psychiatry, Toronto, Ontario, CA, May 14-16, 2015.

312. **Killgore, WD**, Demers, LA, Divatia, S, Rosso, IM, & Rauch, SL. Boosting Emotional intelligence with a brief internet-based program. Abstract presented at the 70th Annual Meeting of the Society of Biological Psychiatry, Toronto, Ontario, CA, May 14-16, 2015.

313. **Killgore, WD**, Vanuk, JR, Alkozei, A, Markowski, SM, Pisner, D, Shane, BR, Fridman, A, & Knight, SA. Greater daytime sleepiness correlates with altered thalamocortical connectivity. Abstract presented at the 70th Annual Meeting of the Society of Biological Psychiatry, Toronto, Ontario, CA, May 14-16, 2015.

314. **Killgore, WD**, Tkachenko, O, Gogel, H, Kipman, M, Sonis, LA, Divatia, SC, Demers, LA, Olson, EA, Buchholz, JL, Rosso, IM, & Rauch, SL. Activation of the ventral striatum predicts overeating during subsequent sleep loss. Abstract presented at the 70th Annual Meeting of the Society of Biological Psychiatry, Toronto, Ontario, CA, May 14-16, 2015.

315. Alkozei, A, Markowski, SM, Shane, BR, Rauch, SL, & **Killgore, WD**. Emotional resilience is not associated with increased emotional resistance to sleep deprivation. Abstract presented at the SLEEP 2015 Meeting, Seattle, WA, June 6-10, 2015.

316. Alkozei, A, Pisner, D, Markowski, SM, Rauch, SL, & **Killgore, WD**. The effect of emotional resilience on changes in appetitie for high-sugary food during sleep loss. Abstract presented at the SLEEP 2015 Meeting, Seattle, WA, June 6-10, 2015.

317. Markowski, SM, Alkozei, A, Rauch, SL, & **Killgore, WD**. Self-perceived invincibility is associated with sleep onset latency and duration. Abstract presented at the SLEEP 2015 Meeting, Seattle, WA, June 6-10, 2015.

318. Markowski, SM, Alkozei, A, Rauch, SL, & **Killgore, WD**. Sex differences in the association between personality and resistance to sleep deprivation. Abstract presented at the SLEEP 2015 Meeting, Seattle, WA, June 6-10, 2015.

319. Shane, BR, Alkozei, A, & **Killgore, WD**. Physical exercise may contribute to vulnerability to sleep deprivation. Abstract presented at the SLEEP 2015 Meeting, Seattle, WA, June 6-10, 2015.

320. Cui, J, Tkachenko, O, Gogel, H, Kipman, M, Sonis, LA, Weber, M, Divatia, SC, Demers, LA, Olson, EA, Buchholz, JL, Rosso, IM, Rauch, SL, & **Killgore, WD**. Resistance to sleep deprivation involves greater functional activation and white matter connectivity within a fronto-parietal network. Abstract presented at the SLEEP 2015 Meeting, Seattle, WA, June 6-10, 2015.

321. Vanuk, JR, Rosso, IM, Rauch, SL, Alkozei, A, Markowski, SM, Pisner, D, Shane, BR, Fridman A, Knight, SA, & **Killgore, WD**. Daytime sleepiness is associated with altered thalamocortical connectivity. Abstract presented at the SLEEP 2015 Meeting, Seattle, WA, June 6-10, 2015.

322. Sneider, JT, Jensen JE, Silveri, MM, & **Killgore, WD**. Prefrontal GABA predicts resistance to

sleep deprivation. Abstract presented at the SLEEP 2015 Meeting, Seattle, WA, June 6-10, 2015.

323. **Killgore, WD**, Tkachenko, O, Gogel, H, Kipman, M, Sonis, LA, Weber, M, Divatia, SC, Demers, LA, Olson, EA, Buchholz, JL, Rosso, IM, & Rauch, SL. Individual differences in rested activation of the ventral striatum predict overeating during sleep deprivation. Abstract presented at the SLEEP 2015 Meeting, Seattle, WA, June 6-10, 2015.

324. **Killgore, WD**, Tkachenko, Rosso, IM, Rauch, SL, & Nickerson, LA. Multimodal neuroimaging to predict resistance to sleep deprivation. Abstract presented at the SLEEP 2015 Meeting, Seattle, WA, June 6-10, 2015.

325. Nickerson, LD & **Killgore, WD**. Resting state brain circuits underpinning a neurobiological model of Theory of Mind and Mentalizing. Abstract presented at the Organization for Human Brain Mapping Annual Meeting, 2015, Honolulu, HI, June 14-18, 2015.

326. Rosso, IM, Olson, EA, **Killgore WD**, Fukunaga, R, Webb, CA, & Rauch SL. A randomized trial of internet-based cognitive behavioral therapy for major depressive disorder. Abstract presented at the 54th Annual Meeting of the American College of Neuropsychopharmacology, Hollywood, FL, December 6-10, 2015.

327. Alkozei, A & **Killgore, WD**. Exposure to blue wavelength light is associated with increased dorsolateral prefrontal cortex responses during a working memory task. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

328. Klimova, A, Pisner, D & **Killgore, WD**. Neural correlates of cognitive and emotional impairments in acute versus chronic mild traumatic brain injury: a diffusion tensor imaging study. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

329. Markowski, S, Alkozei, A, & **Killgore, WD.** Greater neuroticism predicts higher performance in immediate memory, language, and attention in healthy individuals. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

330. Alkozei, A & **Killgore, WD.** Exposure to blue wavelength light suppresses anterior cingulate cortex activation in response to uncertainty during anticipation of negative or positive stimuli. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

331. Smith, R, Alkozei, A, Bao, J, & **Killgore, WD.** Successful goal-directed memory suppression is associated with increased inter-hemispheric coordination between right and left fronto-parietal control networks. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

332. Singh, P, Fridman, A, Pisner, D, Singh, A, & **Killgore, WD.** A voxel based morphometric analysis of ventromedial prefrontal cortex volume related with executive function task

performance post mild traumatic injury. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

333. **Killgore, WD.** Baseline responsiveness of the ventral striatum predicts overeating during subsequent sleep deprivation. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

334. **Killgore, WD** & Nickerson, LD. Predicting resistance to sleep deprivation using multimodal neuroimaging. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

335. Sneider, J, Jensen, JE, Silveri, MM, & **Killgore, WD.** Prefrontal GABA correlates with the ability to sustain vigilance during sleep deprivation. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

336. Buchholz, JL, Olson, EA, Fukunaga, R, Webb, CA, **Killgore, WD**, Rauch, SL, & Rosso, IM. Expressive suppression is associated with greater lateral orbitofrontal cortex volume in adults with major depressive disorder. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

337. Fridman, A, Pisner, D, Singh, P, & **Killgore, WD**. Gray matter volume in left medial prefrontal cortex is related to life satisfaction in individuals with mild traumatic brain injury. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

338. Singh, P, Pisner, D, Fridman, A, Roberts, S, & **Killgore, WD.** Volumetric differences in gray matter in healthy versus overweight/obese individuals post mild traumatic brain injury: A voxel based morphometric study. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

339. **Killgore, WD** & Weber, M. Blue wavelength light therapy reduces daytime sleepiness following mild traumatic brain injury. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

340. **Killgore, WD**, Weber, M, & Penetar, D. Blue wavelength light therapy improves balance following mild traumatic brain injury. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

341. Pisner, D, Smith, R, Alkozei, A, Klimova, A, & **Killgore, WD.** Highways of the emotional intellect: White matter microstructural correlates of an ability-based measure of emotional intelligence. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

342. Vanuk, JR, Smith, R, Knight, S, & **Killgore, WD.** Resting RSA correlates with coordinated resting state activity between brain networks involved in emotion perception. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

343. Vanuk, JR, Alkozei, A, Markowski, S, & **Killgore WD.** Greater resting state functional connectivity within the default mode and task positive networks is associated with trait emotional intelligence. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

344. Fukunaga, R, Webb, CA, Olson, EA, **Killgore, WD**, Rauch, SL, & Rosso, IM. Reduced rostral anterior cingulate volume is associated with greater frequency of negative automatic thoughts in adults with major depressive disorder. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

345. Olson, EA, Fukunaga, R., Webb, CA, Rosso, IM, **Killgore, WD**, & Rauch, SL. Delay discounting and anhedonia are independently associated with suicidal ideation in depression. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

346. Pisner, D, Singh, P, Fridman, A, & **Killgore, WD**. Resilience following mild traumatic brain injury is associated with gray matter volume in the left precentrual gyrus. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

347. Sing, P, Fridman, A, Pisner, D, & **Killgore, WD.** Time dependent differences in gray matter volume in individuals post mild traumatic brain injury: A voxel based morphometric study. Abstract presented at the 44th Annual Meeting of the International Neuropsychological Society, Boston, MA, February 3-6, 2016.

348. Quan, M, Gruber, SA, Lukas, SE, Hill, KP, **Killgore, WD**, & Nickerson, LD. Altered functional connectivity within large-scale brain networks during a cognitive task in chronic marijuana smokers. Abstract presented at the Harvard Psychiatry Research Day, Boston, MA, March 23, 2016. ***[*Semi Finalist Poster: Harvard Medical School Mysell Award]***

349. Fukunaga, R, Webb, CA, Olson, EA, **Killgore, WD**, Rauch, SL, & Rosso, IM. Improvement in negative automatic thoughts as a mediator of symptom improvement in internet-based cognitive behavioral therapy for major depressive disorder. Abstract presented at the 2016 Meeting of the Anxiety and Depression Association of America, Philadelphia, PA, March 31-April 3, 2016.

350. Bernstein, AS, Pisner, D, Klimova, A, Umapathy, L, Do, L, Squire, S, **Killgore, WD**, & Trouard, T. Effects of multiband acceleration on high angular resolution diffusion imaging data collection, processing, and analysis. Abstract presented at the 24th Annual Meeting of the International Society for Magnetic Resonance in Medicine (IMSRM), Singapore, May 7-8, 2016.

351. Alkozei, A, Markowski, SM, Pisner, D, Fridman, A, Shane, BR, Vanuk, JR, Knight, SA, & **Killgore, WD.** Exposure to blue wavelength light reduces activation within the anterior cingulate cortex during anticipation of certain reward stimuli. Abstract presented at the 71st Annual Scientific Convention of the Society for Biological Psychiatry, Atlanta, GA, May 12-14, 2016.

352. Alkozei, A., Pisner, D, Markowski, SM, Vanuk, JR, Fridman, A, Shane, BR, Knight SA, & **Killgore, WD.** Increases in prefrontal activation after exposure to blue versus amber wavelength light during cognitive load. Abstract presented at the 71st Annual Scientific Convention of the Society for Biological Psychiatry, Atlanta, GA, May 12-14, 2016.

353. Pisner, DA, Smith, R, Alkozei, A, Klimova, A, Millan, M, & **Killgore, WD.** Highways of the emotional intellect: White matter mictrostructural correlates of an ability-based measure of emotional intelligence. Abstract presented at the 71st Annual Scientific Convention of the Society for Biological Psychiatry, Atlanta, GA, May 12-14, 2016.

354. Singh, P, Pisner, D, Fridman, A, Singh A, Millan, M, & **Killgore, WD.** A voxel based morphometric analysis of ventromedial prefrontal cortex volume related with executive function task performance post mild traumatic brain injury. Abstract presented at the 71st Annual Scientific Convention of the Society for Biological Psychiatry, Atlanta, GA, May 12-14, 2016.

355. Smith, R, Smith, C, Khodr, O, Nettles, M, Sanova, A, & **Killgore, WD.** Emotional working memory: A relatively unexplored aspect of emotional and cognitive ability. Abstract presented at the 71st Annual Scientific Convention of the Society for Biological Psychiatry, Atlanta, GA, May 12-14, 2016.

356. Smith, R, Nettles, M, Khodr, O, Sanova, A, Smith, C, Alkozei, A, & **Killgore, WD.** Conflict-related dorsomedial frontal activation during healthy food decisions is associated with increased cravings for high-fat foods. Abstract presented at the 71st Annual Scientific Convention of the Society for Biological Psychiatry, Atlanta, GA, May 12-14, 2016.

357. Smith, R, Sanova, A, Nettles, M, Khodr, O, Smith, C, Alkozei, A, Lane, RD, & **Killgore, WD**. Unwanted reminders: The effects of emotional memory suppression on later neuro-cognitive processing. Abstract presented at the 71st Annual Scientific Convention of the Society for Biological Psychiatry, Atlanta, GA, May 12-14, 2016.

358. **Killgore, WD**, Weber, M, Palmer, W, & Penetar, D. Blue wavelength light therapy improves balance following mild traumatic brain injury. Abstract presented at the 71st Annual Scientific Convention of the Society for Biological Psychiatry, Atlanta, GA, May 12-14, 2016.

359. **Killgore, WD**, Tkachenko, O, Palmer, W, & Rauch, SL. Default mode activation predicts vulnerability to sleep deprivation in domains of mood, sleepiness, and vigilance. Abstract presented at the 71st Annual Scientific Convention of the Society for Biological Psychiatry, Atlanta, GA, May 12-14, 2016.

360. Alkozei, A, Markowski, SM, Pisner, D, Fridman, A, Shane, BR, Vanuk, JR, Knight, SA, Grandner, MA, & **Killgore, WD.** Exposure to blue wavelength light reduces activation within the anterior cingulate cortex during anticipation of certain reward stimuli. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

361. Alkozei, A, Pisner, D, Markowski, SM, Vanuk, JR, Fridman, A, Shane, BR, Knight, SA, Grandner, MA, & **Killgore, WD.** Exposure to blue wavelength light is associated with

increased dorsolateral prefrontal cortex responses and increases in response times during a working memory task. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

362. Davis, B, Yang, R, **Killgore, WD**, Gallagher, RA, Carrazco, Alfonso-Miller, P, Gehrels, J, & Grandner, MA. Nightmares in a community sample: Prevalance and associations with daytime function independent of poor sleep quality and depression. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

363. Fisseha, E, Havens, C, **Killgore, WD**, Gallagher, RA, Carrazco, N, Alfonso-Miller, P, Gehrels, J, & Grandner, MA. Sleep duration's important role in the relationship among difficulty concentrating, fatigue, stress, and depressed mood: Data from the SHADES study. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

364. Graham, PM, Goldstein, M, David, BM, Perlis, ML, Perfect, MM, Frye, S, **Killgore, WD**, Carrazco, N, Alfonso-Miller, P, Gehrels, J, & Grandner, MA. Longitudinal analysis of sleep duration using actigraphy and sleep diary: Stability and agreement over 8-11 months. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

365. Granados, K, Rojo-Wissar, DM, Chakravorty, S, Prather, A, Perfect, MM, Frye, S, **Killgore, WD**, Gallagher, RA, Carrazco, N, Alfonso-Miller, P, Gehrels, J, & Grandner, MA. Adverse childhood exposures associated with adult insomnia symptoms. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

366. Grandner, MA, **Killgore, WD**, Khader, W, & Perlis, ML. Positive and negative mood ratings across 24-hours. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

367. Hall, C, Forbush, S, Youngstedt, S, **Killgore, WD**, Barilla, H, Gehrels, J, Alfonso-Miller, P, Palmer, W, Carrazco, N, & Grandner, MA. Habitual sleep duration and health: A possible role for exercise. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

368. Jackson, N, Patterson, F, Seixas, A, Jean-Louis, G, **Killgore, WD**, & Grandner, MA. Using big data to determine the social, behavioral, and environmental, determinants of sleep duration in the U.S. population: Application of a machine learning approach to data from approximately 700,000 Americans. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

369. **Killgore, WD**, Tkachenko, O, Grandner, MA, & Rauch, SL. Default mode activation predicts vulnerability to sleep deprivation in the domains of mood, sleepiness, and vigilance. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

370. **Killgore, WD**, Weber, M, Grandner, MA, & Penetar, DM. Blue wavelength light therapy improves balance following mild traumatic brain injury. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

371. Knight, SA & Killgore, WD. Typical sleep duration is associated with constructive thinking patterns. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

372. Kotzin, MD, Alkozei, A, Knight, SA, Grandner, MA, & **Killgore, WD**. The effects of trait gratitude on quality of sleep, intrusiveness, of pre-sleep cognitions, and daytime energy in healthy individuals. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

373. Markowski, SM, Alkozei, A, McIntosh, MB, Grandner, MA, & **Killgore, WD**. Chronotype and risk-taking propensity. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

374. McIntosh, MB, Markowski, SM, Grandner, MA, & **Killgore, WD**. Prior-night sleep duration is negatively associated with impulsivity in women. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

375. Ocano, D, Jean-Louis, G, **Killgore, WD**, Gallagher, RA, Carrazco, N, Alfonso-Miller, P, Gehrels, J, & Grandner, MA. Sleep duration and decreased social support from family, friends, and significant other: Influence of insomnia and perceived stress level. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

376. Okuagu, A, Perlis, ML, Ellis, JA, Prather, AA, **Killgore, WD**, Gallagher, RA, Carrazco, N, Alfonso-Miller, P, Gehrels, J, & Grandner, MA. Does thinking keep people awake? Or does it matter what they are thinking about? Self-directed cognitions associated with insomnia and insufficient sleep. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

377. Olivier, K, Gallagher, RA, **Killgore, WD**, Carrazco, N, Alfonso-Miller, P, Gehrels, J, & Grandner, MA. Development and initial validation of the Assessment of Sleep Environment: A novel inventory for describing and quantifying the impact of environmental factors on sleep. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

378. Paine, KN, Forbush, S, Ellis, J, Nowakowski, S, Newman-Smith, K, **Killgore, WD**, Gallagher, RA, Carrazco, N, Alfonso-Miller, P, Gehrels, J, & Grandner, MA. Sleep duration and satisfaction with life, health, finances and relationship. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

379. Rhee, JU, Haynes, P, Chakravorty, S, Patterson, F, **Killgore, WD**, Gallagher, RA, Carrazco, N,

Alfonso-Miller, P, Gehrels, J, & Grandner, MA. Susceptibility to smoking during the day and its relationship with insomnia and sleep duration. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

380. Roberts, SE, Singh, P, Grandner, MA, & **Killgore, WD.** Later wake up time and impulsivity. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

381. Saccone, J, Davis, B, Chakravorty, S, **Killgore, WD**, Gallagher, RA, Carrazco, N, Alfonso-Miller, P, Gehrels, J, & Grandner, MA. Habitual caffeine use and motivation to consume caffeine: Associations with sleep duration, sleepiness, fatigue, and insomnia severity. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

382. Singh, A, Fridman, A, Silveri, MM, Grandner, MA, & **Killgore, WD.** Medial prefrontal GABA predicts hunger ratings during sleep deprivation for men but not women. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

383. Vanuk, JR, Alkozei, A, Smith, R, Pisner, D, Markowski, SM, Shane, BR, Fridman, A, Knight, SA, Grandner, MA, & **Killgore, WD.** Changes in heart rate variability due to light exposure predict frontoparietal connectivity. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

384. Vanuk, JR, Alkozei, A, Knight, SA, Fridman, A, Markowski, SM, Pisner, D, Shane, BR, Grandner, MA, & **Killgore, WD.** The effects of light exposure on heart rate variability predict sleepiness and vigilance. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

385. Warlick, C, Chakravorty, S, **Killgore, WD**, Gallagher, RA, Carrazco, N, Alfonso-Miller, P, Gehrels, J, & Grandner, MA. Timing of alcohol intake associated with insomnia symptoms. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

386. Waugaman, DL, Markowski, SM, Alkozei, A, Grandner, MA, & **Killgore, WD.** Chronotype and Emotional Intelligence. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

387. Weber, M, Grandner, MA, & **Killgore, WD.** Smaller gray matter volume of the visual cortex predicts vulnerability to sleep deprivation. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

388. Weber, M, Grandner, MA, & **Killgore, WD.** Blue wavelength light therapy reduces daytime sleepiness following mild traumatic brain injury. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

389. Yang, R, Ocano, D, Chakravorty, S, **Killgore, WD**, Gallagher, RA, Carrazco, N, Alfonso-Miller, P, Gehrels, J, & Grandner, MA. Relationship between insomnia and depression moderated by caffeine. Abstract presented at the 30th Annual Meeting of the Associated Professional Sleep Societies (SLEEP 2016), Denver, CO, June 11-15, 2016.

390. **Killgore, WD**, Vanuk, JR, Pisner, D, Penetar, DM, & Weber, M. Short wavelength light therapy facilitates recovery from mild traumatic brain injury. Abstract presented at the 2016 Military Health System Research Symposium (MHSRS), Orlando, FL, August 15-18, 2016.

391. **Killgore, WD**, Alkozei, A, Smith, R, Divatia, S, & Demers, L. Enhancing emotional intelligence skills with a brief internet-based program: A pilot study. Abstract presented at the 2016 Military Health System Research Symposium (MHSRS), Orlando, FL, August 15-18, 2016.

392. **Killgore, WD**, Rosso, IM, Olson, EA, Webb, CA, Fukunaga, R, Gogel, H, Buchholz, JL, & Rauch, SL. Efficacy of an internet-based cognitive behavior therapy program for major depression. Abstract presented at the 2016 Military Health System Research Symposium (MHSRS), Orlando, FL, August 15-18, 2016.

393. **Killgore, WD**, & Nickerson, LA. Linked analysis of multimodal neuroimaging identifies neural systems associated with the ability to resist sleep deprivation. Abstract presented at the 2016 Military Health System Research Symposium (MHSRS), Orlando, FL, August 15-18, 2016.

394. Vanuk, JR, Allen, JJB, & **Killgore, WD**. Heart rate variability during light exposure and subsequent network connectivity patterns. Abstract presented at the Annual Meeing of the Society for Psychophysiological Research, Minneapolis, MN, September 21-25, 2016

395. Rosso, IM, Olson, EA, Thomas, MO, Webb, CA, **Killgore, WD**, & Rauch, SL. Anterior cingulate cortex morphology predicts remission from major depression following internet-based cognitive behavior therapy. Abstract submitted for presentation at the 55th Annual Meeting of the American College of Neuropsychopharmacology, Holywood, FL, December 4-8, 2016.

396. Franco, J, Millan, M, Shane, BR, Castellanos, A, **Killgore, WD**. Blue wavelength light therapy increases thalamic grey matter volume following mild traumatic brain injury. Abstract accepted for presentation at the 45th Annual Meeting of the International Neuropsychological Society, New Orleans, LA, February 1-4, 2017.

397. Alkozei, A, Smith, R, Demers, LA, Divatia, S, Weber, M, Berryhill, SM, & **Killgore, WD**. Emotional intelligence can be trained via an online training program and is associated with better performance on the IGT. Abstract accepted for oral platform presentation at the 45th Annual Meeting of the International Neuropsychological Society, New Orleans, LA, February 1-4, 2017.

398. Haberman, JT, Olson, EA, Webb, CA, **Killgore, WD**, Rauch, SL, & Rosso, IM. The relation between treatment expectancies and outcome in internet-based cognitive behavioral therapy for major depressive disorder. Abstract presented at the Association for Behavioral and Cognitive Therapies, New York, NY, October 27-30, 2016.

AWARDED GRANTS AND CONTRACTS

Completed

2001-2003 fMRI of Unconscious Affect Processing in Adolescence.
NIH, 1R03HD41542-01
PI: **Killgore** ($79,000.)

2003-2006 The Effects of Sleep-Loss and Stimulant Countermeasures on Judgment and Decision Making.
U.S. Army Medical Research and Materiel Command (USAMRMC) Competitive Medical Research Proposal Program (CMRP); Intramural Funding,
PI: **Killgore** (Total Award: $1,345,000.)

2004-2005 Sleep/wake Schedules in 3ID Aviation Brigade Soldiers.
Defense Advanced Research Projects Agency (DARPA)
PI: **Killgore** (Total Award: $60,000.)

2005-2006 Functional Neuroimaging Studies of Neural Processing Changes with Sleep and Sleep Deprivation.
U.S. Army Medical Research and Materiel Command (USAMRMC); Intramural Funding Task Area C (Warfighter Judgment and Decision Making) Program Funding
PI: **Killgore** (Total Award: $219,400.)

2006-2007 Establishing Normative Data Sets for a Series of Tasks to Measure the Cognitive Effects of Operationally Relevant Stressors.
U.S. Army Medical Research and Materiel Command (USAMRMC); Intramural Funding Task Area C (Warfighter Judgment and Decision Making) Program Funding,
PI: **Killgore** (Total Award: $154,000.)

2006-2007 Military Operational Medicine Research Program (MOM-RP), Development of the Sleep History and Readiness Predictor (SHARP).
U.S. Army Medical Research and Materiel Command (USAMRMC); Intramural Funding
PI: **Killgore** (Total Award:$291,000.)

2009-2014 The Neurobiological Basis and Potential Modification of Emotional Intelligence through Affective Behavioral Training (W81XWH-09-1-0730).
U.S. Army Medical Research and Materiel Command (USAMRMC),
PI: **Killgore** (Total Award: $551,961.)
Major Goal: To identify the neurobiological basis of cognitive and emotional intelligence using functional and structural magnetic resonance imaging.

2011-2014 Effects of Bright Light Therapy on Sleep, Cognition, and Brain Function following Mild Traumatic Brain Injury (W81XWH-11-1-0056).
U.S. Army Medical Research and Materiel Command (USAMRMC),
PI: **Killgore** (Total Award: $941,924)
Major Goal: To evaluate the effectiveness of morning exposure to bright light as a treatment for improving in sleep patterns among individuals with post-concussive syndrome. Effects of improved sleep on recovery due to this treatment will be evaluated using neurocognitive testing as well as functional and structural neuroimaging.

2012-2014 Neural Mechanisms of Fear Extinction Across Anxiety Disorders
NIH NIMH
PI: Milad, M. Site Subcontract PI: **Killgore** (Subcontract Award: $505,065)
Major Goal: To examine the neurocircuitry involved in fear conditioning, extinction, and extinction recall across several major anxiety disorders.

2012-2014 Multimodal Neuroimaging to Predict Cognitive Resilience Against Sleep Loss
Defense Advance Research Projects Agency (DARPA) Young Faculty Award in Neuroscience (D12AP00241)
PI: **Killgore** (Total Award: $445,531)
Major Goal: To combine several neuroimaging techniques, including functional and structural magnetic resonance imaging, diffusion tensor imaging, and magnetic resonance spectroscopy to predict individual resilience to 24 hours of sleep deprivation.

2012-2015 Internet Based Cognitive Behavioral Therapy Effects on Depressive Cognitions and Brain function (W81XWH-12-1-0109).
U.S. Army Medical Research and Materiel Command (USAMRMC),
PI: Rauch, SL; Co-PI: **Killgore** (Total Award: $1,646,045)
Major Goal: To evaluate the effectiveness of an internet-based cognitive behavioral therapy treatment program on improving depressive symptoms, coping and resilience skills, cognitive processing and functional brain activation patterns within the prefrontal cortex.

Current

2012-2016 A Model for Predicting Cognitive and Emotional Health from Structural and Functional Neurocircuitry following Traumatic Brain Injury (W81WH-12-0386)
Congressionally Directed Medical Research Program (CDMRP), Psychological Health/Traumatic Brain Injury (PH/TBI) Research Program: Applied Neurotrauma Research Award.
PI: **Killgore** (Total Award: $2,272,098)
Percent Effort: 25%
Major Goal: To evaluate the relation between axonal damage and neurocognitive performance in patients with traumatic brain injury at multiple points over the recovery trajectory, in order to predict recovery.

2014-2017 Bright Light Therapy for Treatment of Sleep Problems following Mild TBI (W81XWH-14-1-0571).

Psychological Health and Traumatic Brain Injury Research Program (PH/TBI RP) Traumatic Brain Injury Research Award-Clinical Trial.
PI: **Killgore** (Total Award: $1,853,921)
Percent Effort: 40%
Major Goal: To verify the effectiveness of morning exposure to bright light as a treatment for improving in sleep patterns, neurocognitive performance, brain function, and brain structure among individuals with a recent mild traumatic brain injury.

2014-2018 A Non-pharmacologic Method for Enhancing Sleep in PTSD (W81XWH-14-1-0570)
Military Operational Medicine Research Program (MOMRP) Joint Program Committee 5 (JPC-5), FY13 Basic and Applied Psychological Health Award (BAPHA)
PI: **Killgore** (Total Award: $3,821,415)
Percent Effort: 35%
Major Goal: To evaluate the effectiveness of blue light exposure to modify sleep in PTSD and its effects on fear conditioning/extinction, symptom expression, and brain functioning.

2015 Effects of Blue Light on Melatonin Levels and EEG Power Density Spectrum
Arizona Area Health Education Centers (AHEC) Program
Co-PI: Alkozei, A.; Co-PI: **Killgore** (Total Award: $4,373)
Percent Effort: 0%
Major Goal: Adjunctive intramural funding to add a melatonin collection to an ongoing study of the effects of blue wavelength light on alertness and brain function.

2014-2018 Refinement and Validation of a Military Emotional Intelligence Training Program (JW150005)
Joint Warfighter Medical Research Program 2015
PI: **Killgore** (Total Award: $5,977,570)
Percent Effort: 45%
Major Goal: To develop and validate a new internet-based training program to enhance emotional intelligence capacities in military Service Members.

LIST OF COLLABORATORS ON GRANTS AND PUBLICATIONS FROM LAST FIVE YEARS

Acharya, D.
Alkozei, Anna
Athey, A. J.
Baker, Justin. T.
Balkin, Thomas J.
Bark, John S.
Brennan, Brian P.
Britton, Jennifer C.
Bruyere, J.
Buchholz, Jennifer L.
Capaldi, Vincent F.
Castro, Carl A.
Chosak, A.
Cohen-Gilbert, Julia E.
Conrad, Turner A.
Covell, Michael J.
Crowley, David J.
Cui, Jiaolong

Dagher, Joseph
Dahlgren, Mary Kate
Deckersbach, Thilo
DelDonno, Sophie R.
Demers, Lauren A.
Dillon, Daniel G.
Divatia, Shreya C.
Dougherty, Darin
Engle, Charles C.
Estrada, Arthur
Freed, Michael C.
Fridman, Andrew
Fukunaga, Rena
Ginsberg, Jay P.
Gogel, Hannah
Gold, Andrea L.
Gonenc, Atilla
Gruber, Staci A.
Grugle, Nancy, L.
Guerrero, Melanie L.
Hammeroff, Stuart
Hartman, A. S.
Hezel, D.
Hoge, Charles W.
Hudson, James I.
Jenike, Michael A.
Jensen, J. Eric
Jorgensen, Alli L.
Juelich, R. J.
Kamimori, Gary H.
Kamiya, T.
Kaufmann, Marc
Kawada, Y.
Kelley, Amanda M.
Killgore, Desiree B.
Kipman, Maia
Kizielewicz, Jill
Knight, Sara A.
Koehlmoos, T. P.
Krizan, Zlatan
Krupnick, J.
Lane, Richard
Lasko, N. B.
Laundau, A. J.
Leibenluft, E.
Makris, Nicos
Marin, M. F.
Markowski, Sarah M.
Meloni, Edward G.
Milad, Mohammed R
Mundy, Elizabeth A.
Nickerson, Lisa D.
Novak, L.A.
Olson, Elizabeth A.
Orr, Scott P.
Pace-Schott, Edward F.
Papadimitriou, G.
Pauls, D. L.
Pechtel, Pia
Penetar, David M.
Pine, Daniel S.
Pisner, Derek
Pitman, R. K.
Pizzagalli, Diego A.
Pollack, M. H.
Pope, Harrison G.
Post, Alex
Preer (Sonis), Lilly

Price, Lauren M.
Racine, Megan T.
Ragan, J.
Raison, Charles L.
Rauch, Scott L.
Rauch, Shiela
Reichardt, Rebecca M.
Renshaw, Perry F.
Rizzo, Albert (Skip)
Rohan, Michael
Ross, Amy J.
Rosso, Isabelle M.
Rupp, Tracy L.
Ryan, E. M.
Sagar, Kelly A.
Schoenberg, Michael R.
Schwab, Zachary J.
Shane, Bradley R.
Silveri, Marisa M.
Simon, Naomi M.
Smith, Kacie L.
Smith, Ryan S.
Sneider, Jennifer T.
Song, Christina H.
Song, H.
Steward, S. E.
Thomas, Jennifer J.
Tkachenko, Olga
Trksak, George H.
Vanuk, John R.
Webb, Christian A.
Weber, Mareen
Weihs, Karen
Weiner, Melissa R.
Whte, C. N.
Wilhelm, S.
Yurgelun-Todd, Deborah, A.
Zai, D.

GRADUATE, POSTDOCTORAL, THESIS ADVISORS OR SPONSORS

Steven W. Gangestad, Ph.D.—Undergraduate Senior Honors Thesis Advisor

Lawrence Overby, III, Ph.D.—Masters Thesis Advisor

Bill J. Locke, Ph.D.—Doctoral Thesis Advisor

Keith A. Hawkins, Ph.D.—Doctoral Internship Advisor

Russell L. Adams, Ph.D.—Postdoctoral Fellowship Advisor

James G. Scott, Ph.D.—Postdoctoral Fellowship Advisor

Guila Glosser, Ph.D.—Postdoctoral Fellowship Advisor

Deborah A. Yurgelun-Todd, Ph.D.—Postdoctoral Fellowship Advisor

This is a true and accurate statement of my activities and accomplishments. I understand that misrepresentation in securing promotion and tenure may lead to dismissal or suspension under ABOR Policy 6-201 J.1.b.

William D. “Scott” Killgore, Ph.D.